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PENNSYLVANIA ANTHRACITE



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Pennsylvania Anthracite



**STATE PLANNING BOARD
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Harrisburg, 1952

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FOREWORD

Despite many studies made of Pennsylvania anthracite in the past twenty years, the necessity for a brief factual report on this important fuel has become evident. Masses of statistics have revealed, often only to bury again, the simple underlying facts that are so important to a million people in our northeastern counties.

Anthracite is the one important mineral product in which our Commonwealth has a virtual monopoly in the western world. The anthracite reserves of Pennsylvania represent a source of heat energy which may at any time prove to be of inestimable importance to our Nation. Anthracite is not directly competitive with any other of the resources of fuel energy in supplying energy for industrial production or the national defense. As a consequence, it provides for the northeastern section of our country the assurance of warm homes and the continuance of civilized standards of living despite any demands which may ever be made upon our oil, our gas or our bituminous coal.

At various times in the past, casual analysts and observers have been ready to write off anthracite as a modern fuel and to dismiss as unimportant the contribution which the industry can make to the economic progress of our State and Nation, but a careful reexamination of the possibilities and problems of hard coal reveals that such assumptions have no basis in reality.

It is not too much to say that in 1952 the anthracite industry is as virile and as forward-looking as it has ever been. True, it does not sell as many tons of coal or employ as many workers as it did a generation ago. The industry's new-found strength, however, lies in the recognition of these facts plus a united determination to retain its 5,000,000 home market and to expand anthracite's use as an industrial fuel.

This booklet has been prepared to present the current picture of this unique and important Pennsylvania industry.

Pennsylvania Planning

To inform those who
are interested and
to interest others.

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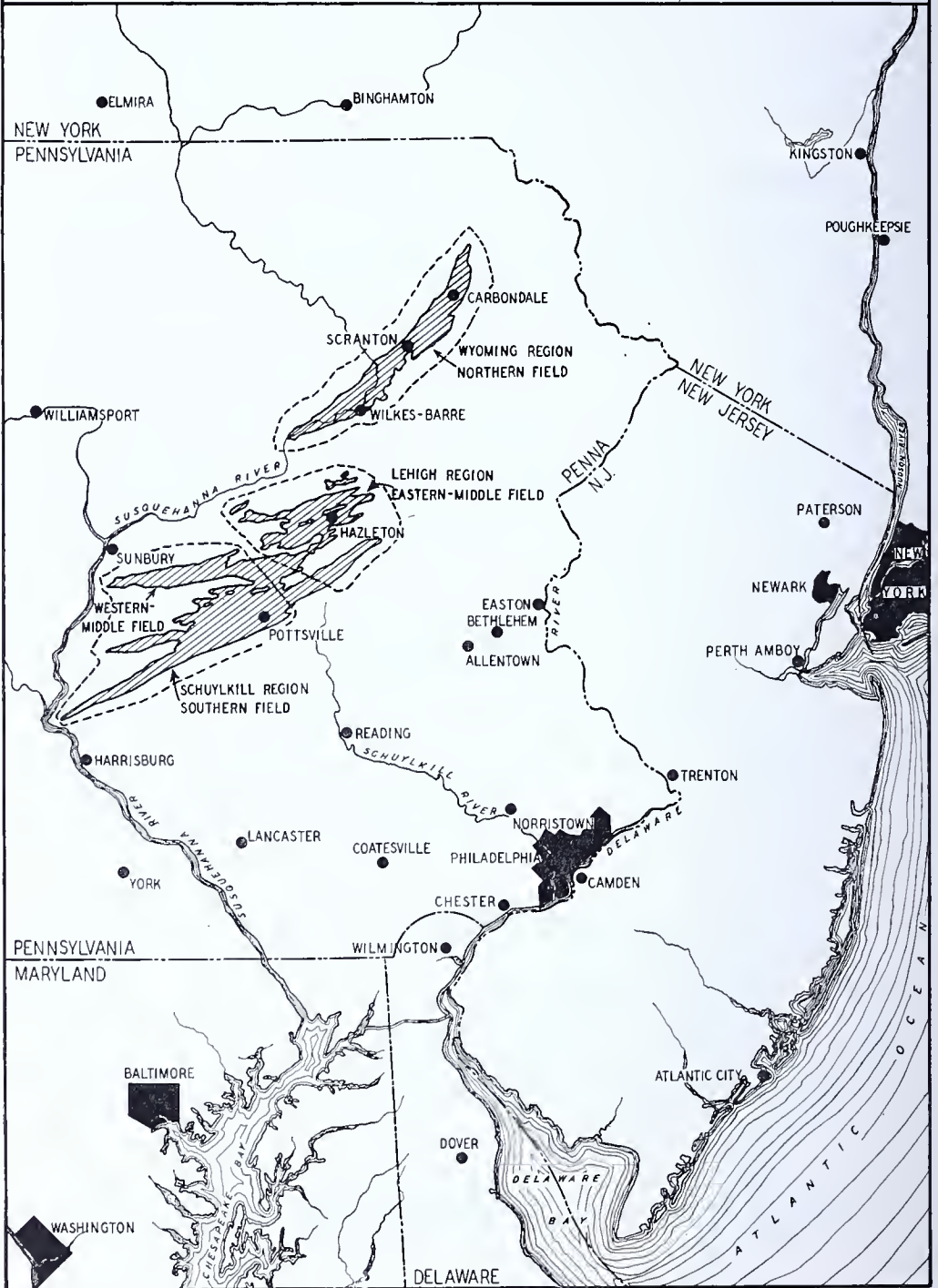
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THE ANTHRACITE FIELDS AND NEAR-BY MARKET AREA



Pennsylvania Anthracite

At Mid-Century

Pennsylvania anthracite was discovered in 1762 but was at first regarded only as a curiosity. Commercial production started in 1820. This stimulated the development of many native industries. An extensive canal system and afterwards an elaborate network of railroads were constructed at great cost to bring the products of the hard coal mines to coastal and interior markets. The availability of this fuel made possible the tremendous 19th century growth of Philadelphia and New York and the early dominance of our State in the production of iron and steel.

It is sometimes assumed that, despite its great contribution to the industrial and social development of the northeastern states, anthracite belongs to a stage in the growth of our nation which has been passed by in the irresistible movement toward new and improved methods of providing comforts and conveniences for the American public. This is a wholly erroneous judgment.

It can be safely stated at once and with every possible emphasis, that hard coal is not in any sense out-moded by more recently developed fuels or heating devices, that within the area where its use has become established it has remained cheaper than comparable fuel products, and that the available reserves will provide coal at present or even at increased rates of consumption over a period of at least 150 years.

At the time of the highest popularity of hard coal, the decade from 1910 to 1920, no dream of automatic heating devices had arisen to discontent the American householder with his traditional winter tasks of stoking a furnace fire and regulating its drafts.

Anthracite was an ideal fuel during those non-automatic years. The number of customers grew far faster than the growth of population, and, no wonder. This was a fuel that yielded intense heat without smoke. It did not form tarry masses in the fire box. It maintained an even heat with a natural draft. With reasonable skill, a fire once lighted in the autumn might be kept burning during the entire winter. No such conveniences as these had ever been offered by any fuel known to man.

The years which have seen a drop of nearly fifty percent in the demand for hard coal have not witnessed any loss in these valuable properties. Anthracite is still relatively cheap. It burns without smoke and the public is more sensitive to smoke than ever before. It presents no fire hazard. It provides a steady and easily maintained rate of combustion. The only serious deterrents to the universal acceptance of anthracite within its marketing area are those same winter tasks which were regarded as inevitable a generation ago.

Fortunately, the situation has been changed in recent years by the efforts of the coal producing companies and their more progressive dealers, but much remains to be done if wide public acceptance of anthracite is ever to be regained.

The operators of anthracite mines have joined forces in the creation and support of the Anthracite Institute, which has engaged in intensive research leading to the development of radically new anthracite burning equipment. The Institute undertakes the testing of all anthracite burning devices, both automatic and non-automatic, and is also the principal agency for publicizing anthracite to dealer and consumer.

The Annual Anthracite Conferences at Lehigh University have become important factors in coordinating the efforts of combustion engineers and research physicists in solving the problems of the industrial application of anthracite, the development of new non-fuel uses for the product, the improvement of heating devices and the development of a modern approach to the problems of merchandising hard coal. Through these and other agencies, including the research laboratories of the School of Mineral Indus-



Anthracite mining is a highly skilled operation. The safety record of hard coal has improved steadily over the past eighty years.

tries, The Pennsylvania State College, great progress has been made within the past ten years in facing the facts forced upon the attention of the industry by the declining level of demand evidenced after 1917.

The Pennsylvania State government, through its Department of Mines, has been concentrating its efforts for more than two generations on the reduction of fatalities in the extraction of coal. In 1950, the number of deaths in the anthracite mines was the lowest ever recorded, less than one-fifth that of twenty years ago. Constant inspection of the mines has led to steady improvement in the safety of mining operations so that the number of fatalities per million tons mined is not one-eighth of that prevailing when the Department first undertook its task of promoting mine safety, in the year 1870.

The quality of anthracite is now protected by rigid laws which provide assurance to the purchaser of any hard coal sold as "Standard Grade" anthracite that he is buying a superior and approved product. This law is administered by the Anthracite Committee, of which the Pennsylvania Secretary of Commerce is Chairman.

Those who have made the closest study of the outlook for hard coal in comparison with all other available domestic fuels believe that the efforts of these agencies, together with the cooperation of the thousands of coal dealers, the mine operators and mine workers can eventually restore anthracite to its rightful position as a superior smokeless fuel for the heating of all types of dwellings within its natural marketing area in the northeastern United States.

The position of the anthracite industry in 1952 may be briefly summarized as follows:

1. Within a limited area surrounding the anthracite fields, an area containing more than twenty million people, the hand-fired anthracite furnace provides the least expensive solution to the heating problem of low-cost and low-rental homes. Thermostatic control adds greatly to the convenience of hand-fired heating devices at a minimum cost.

2. Although automatic devices for the burning of anthracite came later on the market than those for the burning of either oil or gas, they are now available in many efficient and well-tested forms. Within the anthracite market area the use of this equipment provides automatic smokeless heat at a lower cost than is obtainable from any other fuel. Against the lower cost must be set the inconvenience of ash removal and the higher first cost of an anthracite stoker as compared to a gas or oil burner. The balance of advantages and disadvantages between oil or gas and coal is thus indecisive. Salesmanship and service could determine the outcome of this competitive battle.

3. In the automatic field, coal stokers cannot hope to gain wide acceptance in competition with oil or gas burners until anthracite retail dealers are willing to supply a complete fuel service, which includes the delivery of

coal on a degree-day basis and, wherever desired, the removal of ashes, as well as the maintenance of equipment.

4. One consequence of the geological conditions under which anthracite was formed is the fact that in addition to the domestic or hand-fired sizes (egg, stove, chestnut and pea), which command a premium in the market, there is also produced a large tonnage of small sizes which must now be sold at or below actual cost of production. This compels higher prices for the domestic sizes than would be necessary if the small size coal could be sold at a reasonable advance above the cost of mine labor.

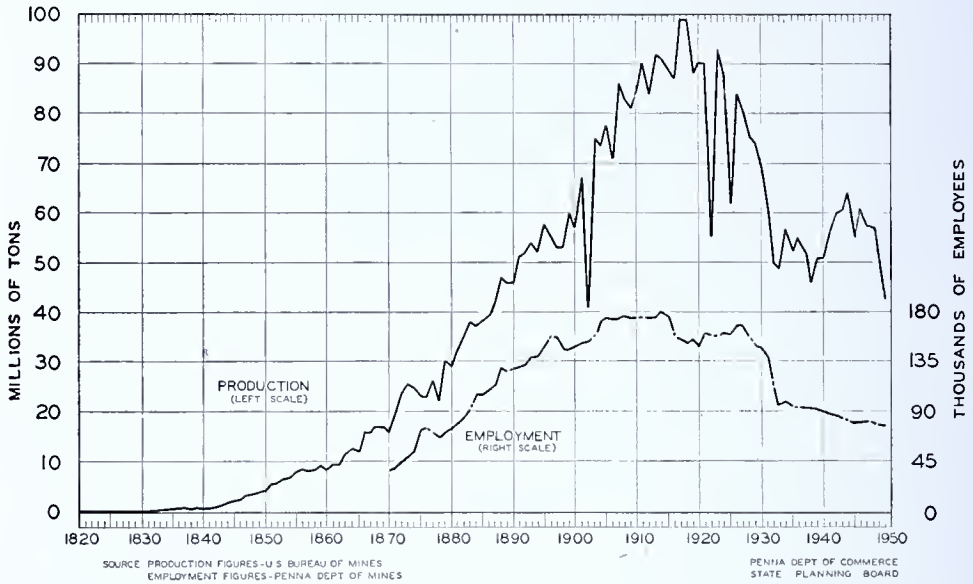
The problem of improving the relative cost position of anthracite to a point where the advantage of its price becomes decisive depends in part on wider markets being established and a larger demand created for the rice, barley and buckwheat sizes. This can occur only through promotion of automatic burning devices and the development of further industrial and public utility demand for steam sizes.

5. Any further rise in the price of hard coal relative to gas and oil will be rapidly reflected in a decline in demand and employment. If the prevailing price advantage is increased or maintained and through research further industrial uses are developed for the steam sizes in the chemical and metallurgical fields there will be generations of profitable operation ahead for the industry.

6. Cost of mining is higher for anthracite than for other competitive fuels, partly because of the lack of tested automatic mining machinery suited to conditions met with in the field, and partly because of accumulated underground water pools in the area.

The clean-burning, smokeless properties of anthracite, the certainty of supply and a price advantage in both fuel and maintenance costs are powerful weapons in the competitive battle with oil and gas. Nobody, however, can assure hard coal of its proper share of the fuel market but the mine owners, the anthracite railroads, the miners and the coal dealers. Their cooperation toward the achievement of lower costs and a more aggressive salesmanship would be a decisive factor in the rejuvenation of the industry.

ANTHRACITE PRODUCTION AND EMPLOYMENT



Anthracite production reached its peak during the First World War. Present employment is less than half that of the 1905-1915 decade.

To put the problem with a somewhat deceiving simplicity, these two questions are of paramount importance to those concerned with the future of hard coal:

1. *Can the retail price of anthracite be maintained at a decisively lower level per unit of heat than that of competitive fuel while methods of merchandising and servicing are improved to increase the competitive appeal of hard coal?*
2. *Can demand be increased and new uses developed for the steam sizes?*

Production, labor, transportation, merchandising and equipment manufacturing all will play an important role in formulating the answers to these questions.

MAINTAINING A PRICE ADVANTAGE

Since, in dealing with the problem of anthracite, we are considering a fuel whose market is primarily domestic, it is not merely the economic but also the psychological effect of price changes which has to be considered.

Over the longer term, anthracite prices have been more stable and have increased less than those of competing fuels, as shown by the index of changes between 1945 and 1949 in Table I for New York City, the largest consumer of hard coal. Between 1949 and 1951, however, anthracite prices rose more rapidly than those of bituminous coal and fuel oil. Consumer sensitivity to short term price movements cannot be overlooked, particularly those occurring at a time when construction activities are at a peak and the competition of oil and gas for new installations is more intense than at any time since the close of the First World War. It is unnecessary to point out the danger of duplicating the circumstances which were so disastrous thirty years ago, when the anthracite industry was not alerted to the possible effect of short term price movements.

TABLE I

Retail Price Movements 1945-1951

Residential Heating Fuels

NEW YORK CITY (1945=100)

		<i>Anthracite Chestnut Dollars per Ton</i>		<i>Anthracite Buckwheat No. 1 Dollars per Ton</i>		<i>Bituminous Stoker Dollars per Ton</i>		<i>Fuel Oil No. 2 Cents per Gallon</i>	
<i>December</i>	<i>Index</i>			<i>Index</i>		<i>Index</i>		<i>Index</i>	
1945	15.23	100.0		10.49	100.0	9.90	100.0	7.60	100.0
1947	18.54	121.7		12.68	120.9	13.41	135.5	12.11	159.3
1949	21.26	139.6		14.05	133.9	14.75	149.0	12.02	158.2
Oct., 1951	24.89	163.4		15.88	151.4	15.60	157.6	12.75	167.8

SOURCE: Calculated from Bureau of Labor Statistics data.

Comparative Costs

Apart from the psychological effect of price movements, comparative cost presents a *positive* reason for the selection of one fuel over the other. In those areas where anthracite can be profitably marketed, hard coal has met its most severe competitor in fuel oil. To compare relative economics of these two fuels some common basis such as cost per therm must be established, the therm being equivalent to 100,000 B.T.U.'s of heat content.

TABLE II

Cost in Cents per Therm

RESIDENTIAL HEATING FUELS—OCTOBER, 1951

	<i>Anthracite</i>				<i>No. 2 Fuel Oil</i>
	<i>Chest- nut</i>	<i>Pea</i>	<i>No. 1 Buck- wheat</i>	<i>No. 2 Buck- wheat</i>	
Scranton	6.52	5.35	4.08	3.53	N.A.
Philadelphia	8.55	7.24	5.85	5.02	8.78
Baltimore	8.59	7.44	6.18	N.A.	8.95
Buffalo	9.35	N.A.	6.58	5.88	9.88
New York	9.57	7.79	6.23	5.50	9.17
Portland, Me.	9.09	N.A.	6.70	N.A.	8.92
Milwaukee	9.84	8.67	N.A.	N.A.	9.96

N. A. —Not Available.

NOTE: Anthracite heating values in therms per ton are assumed to be Chestnut—260; Pea—257; No. 1 Buckwheat—255; No. 2 Buckwheat (Rice)—250. Fuel Oil heating values in therms per gallon are assumed to be: Kerosene—1.34; No. 1 (range oil)—1.36; No. 2 (domestic heating oil)—1.39.

SOURCES: All price data from U. S. Bureau of Labor Statistics except for Buckwheat No. 2, which was supplied by Anthracite Institute. Heating values from Anthracite Institute, American Petroleum Institute and A.S.H. & V.E. Guide.

In order to determine comparative heating costs, the foregoing figures should, theoretically, be adjusted by dividing by an efficiency factor. Probably the most useful factor for this purpose is the "Overall House Efficiency," as defined by the Engineering Experimental Station of the University of Illinois.

TABLE III

Overall House Efficiencies in Research Residence

<i>Method of Firing</i>	<i>Efficiency Ratio</i>
Oil Conversion	.72
Bituminous, Hand-Fired	.75
Oil Burning Furnace	.82
Anthracite, Hand-Fired	.90

SOURCE: Konzo, Seichi, "The Stoker-Fired Warm Air Furnace in the Research Residence." Paper XII, Engineering Experimental Station Bulletin, Circular Series No. 39, University of Illinois.

Overall house efficiency is defined as the ratio of the heat loss from the house to the heat input to the furnace. The values tabulated above are based on an indoor-outdoor temperature difference of 34°F, and were obtained with an automatically controlled forced-air heating system using an outside chimney. It is fully realized that efficiencies obtained in carefully controlled laboratory experiments do not apply to an actual installation fired by an untrained person. Nevertheless, Table III indicates that anthracite is capable of performing more efficiently than either oil or soft coal under controlled conditions of hand-firing, and that the slower rate of combustion and consequent lower stack losses do present a positive advantage inherent in all anthracite burning equipment.

From the standpoint of anthracite, it appears conservative, on the basis of this evidence, to assume that actual heating cost will be directly related to fuel cost per therm.

It may be noted from Table II that, *for the selected cities, all sizes of anthracite smaller than chestnut exhibited a price advantage over domestic fuel oil.*

If buckwheat No. 1 and No. 2, the sizes generally used in household stokers, are compared with domestic fuel oil, the price advantage of anthracite is emphasized. *Excluding Scranton, which is in the center of the mining region, automatic sizes of anthracite were between 25 and 40 per cent cheaper than fuel oil in each of these major cities.*

Chestnut anthracite also was cheaper than fuel oil No. 2 in every city but New York and Portland. In these two cases oil held a slight advantage as far as fuel costs are concerned.

The price of fuel is however not the only factor in determining heating cost. The domestic sizes of anthracite (pea and larger) are generally used in hand-fired furnaces, which are the least expensive to purchase and maintain of all central heating units. For modest-income families, unable to afford automatic heat, the low first cost of manually-fired hard coal equipment is a factor heavily in favor of anthracite wherever equipment costs are a major consideration.

The number of hand-fired coal burning heating devices sold has exceeded that of oil or gas-fired space heaters of every type for the past several years. Current data on the percentage of these hand-fired devices to be used for burning anthracite are not presently available but, undoubtedly, a great market still exists for all types of hand-fired equipment. This is true despite the fact that anthracite's contribution to the domestic heating fuels consumed within its marketing area declined by 29% between 1945 and 1949.

Hand-fired equipment operates independently of all public utilities. Power failure caused by storm or other public emergency does not affect the heating of a home dependent on this simpler type of furnace and, as with any type of Anthracite burner, fuel supply is not endangered by industrial demand or by the necessities of the national defense.

Great efforts have recently been made by the oil industry and even by many coal dealers to sell low-cost oil burning equipment to coal users. If the present price advantage of domestic hard coal is further reduced a strong incentive will be provided for modest income families to install some form of oil or gas equipment.

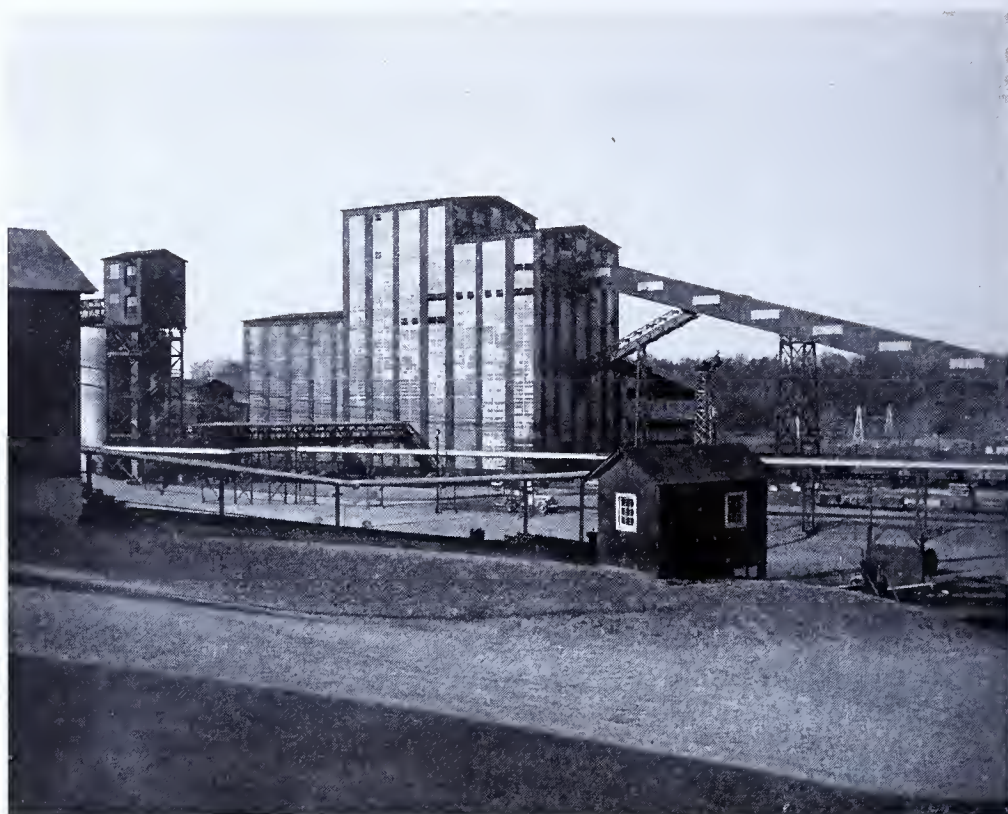
How far the luxury demand for automatic heating equipment will expand is a matter of conjecture. It is not, however, a matter of conjecture that the anthracite industry, which produces approximately 40 percent of steam size coal and 60 percent of domestic sizes, has not found a profitable market for its fine coal, and because of a lack of a profitable market (which automatic heating could provide) must shave more and more closely its price advantage over competitive fuels.



Modern anthracite stokers provide clean efficient heat and are completely automatic.

Excellent units are now available for the automatic combustion of small sizes of hard coal. In some cases, notably the new boiler-burner and furnace-burner units, anthracite equipment is competitively priced with oil equipment. However, anthracite conversion stokers are higher priced than comparable equipment for oil. Gas equipment is considerably lower in cost than either. It is obvious that to provide adequate inducement for installing an automatic anthracite burner the retail price of the fuel to be used must remain sufficiently below the cost of equivalent heating units of oil or gas to balance the added first cost of hard coal equipment and the inconvenience of ash removal if that inconvenience is not overcome by such dealer services as are suggested in a later section of this report.

The cooperation, which has of late years led to the formation of the Anthracite Institute and its outstanding success in the development of the Anthratube, the Anthra-



The breaker of a modern anthracite mine.

flo, and its testing and improvement of numerous stokers and other devices for the control of automatic, semi-automatic and hand-fired equipment represent a notable advance in meeting the competition of gas and oil. In addition to the fine automatic equipment now available for residential use, equipment manufacturers, with the assistance of the research facilities of Anthracite Institute, have developed outstanding commercial and industrial automatic equipment which has already built up demand for a considerable tonnage of the steam sizes. An industry whose product in 1950 was valued at nearly 407 million dollars, has every incentive to engage in the type of vigorous and unified promotional effort which its important place in the American economy fully justifies.

Selling its product in the midst of a great industrial area, the busiest in the world, it possesses one unique and stra-



More than three thousand miles of underground railway operate under Pennsylvania's hills.

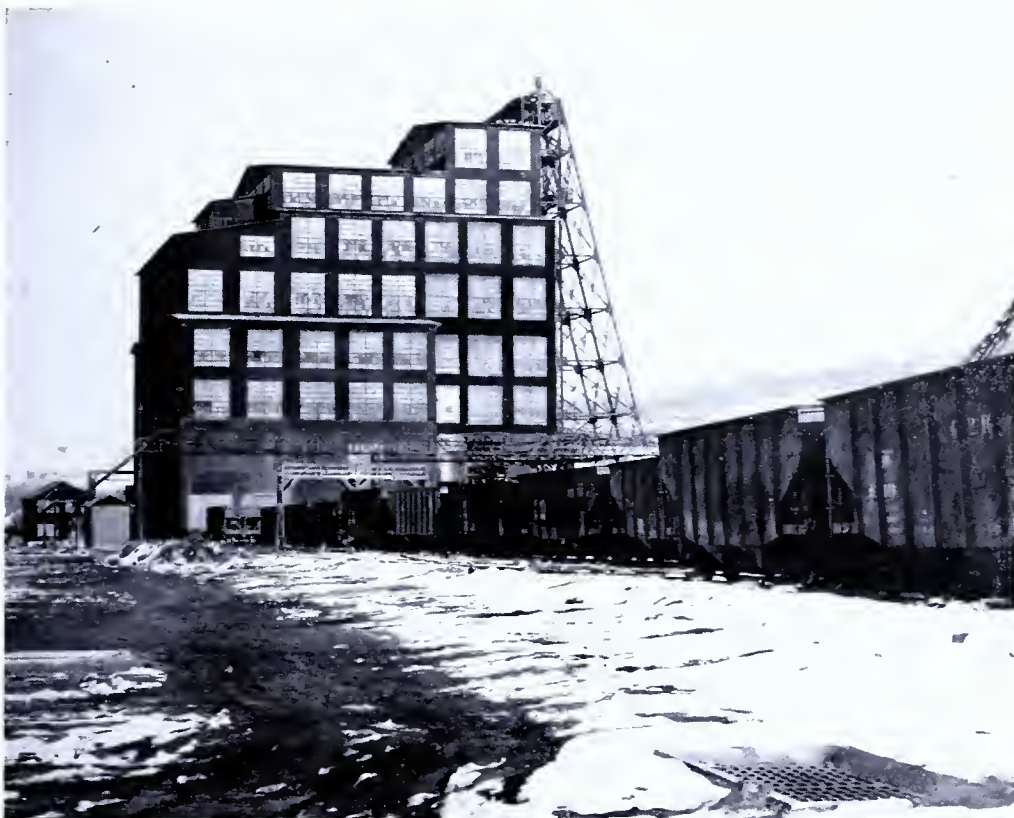
tegic advantage—the heavy demands of war and peace for industrial fuels do not directly affect the available supply of anthracite. With known resources adequate to supply the needs for domestic fuel in its territory for the next 150 years, the anthracite industry has every incentive for a united effort to eliminate any impediment to the promotion of its product by all those connected with its production, transportation and sale.

To summarize briefly, the vital and in fact the essential condition for the retention and expansion of the anthracite market is the maintenance of a price advantage over competing fuels. A reasonable assurance of such a price advantage would create the proper psychological background for expanding the use of hard coal, would maintain the economy of hand-firing with domestic sizes of

anthracite for those families not able to afford automatic heating, and would provide a strong economic motive for purchase of automatic coal burning equipment in competition with oil or gas.

There are only two ways in which such a price advantage can be secured or maintained. One is by cost reductions all along the line between the unmined coal and the effective heat delivered in the consumer's home. Unquestionably, such cost reductions will be difficult to effect and would be impossible unless all factors of the industry united in an effort to bring them about and to participate in a program of publicity for hard coal which will yield positive results in increased volume for the dealer and producer, and the assurance of higher weekly earnings to mine labor through more days of work.

The second method by which anthracite can be placed in a better competitive position must be through developing an increased demand for the steam sizes which are now sold at distress prices, throwing an unnecessary cost burden on all the more desired sizes. These two possibilities must now be examined in turn.



Anthracite demand is greatest during the winter months but for efficient operation mines should produce steadily throughout the year.

THE PROBLEM OF COSTS

For chestnut anthracite, typical of the domestic sizes, production costs account for approximately 65 cents of the retail dollar, retailing costs for 20 cents and freight costs for 15 cents. For rice coal, typical of the steam sizes, the cost might be of the order: 55 cents, 25 cents and 20 cents for mining, retailing and freight, respectively. These figures are based on the average railroad haul for hard coal, which is approximately 170 miles. Where the fuel must be hauled for distances further than this, freight rapidly becomes the dominant and limiting factor.

Can Mining Costs be Lowered?

Reduction in the cost of mining would reduce the retail price of anthracite more than a like percentage reduction in any other element of cost. To what extent is this possible?

Because of their geologic history and their location in the Appalachian area of folds and pressures, anthracite deposits occur normally at sharp angles to the horizontal and must be followed down to considerable depth. As compared to the average type of geologic structure in bituminous coal districts, anthracite presents problems which can be solved only at a higher operating cost. The output per man day in anthracite mining is consequently below that in the bituminous fields. This is illustrated in the table shown below.

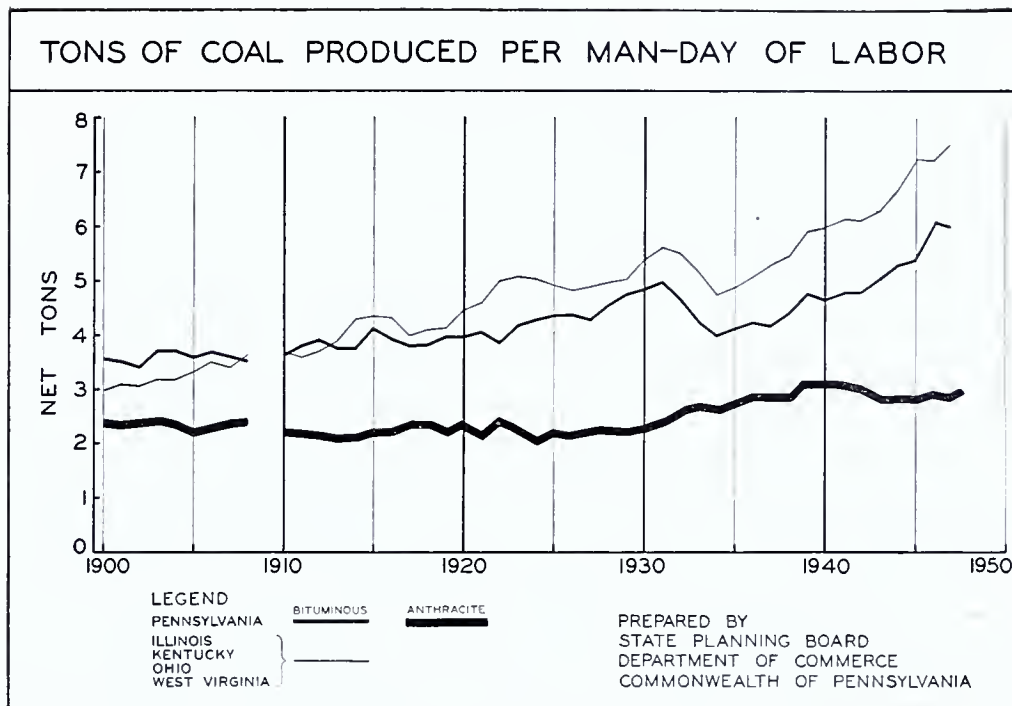
Considering the very moderate increase in output per man day in the past generation from 2.12 tons in 1925 to 2.87 tons in 1949 despite the growth of stripping operations which in 1950 accounted for 26.5% of all anthracite mined, it appears that technological advances in anthracite mining have little more than balanced the increasing difficulty of extraction.

TABLE IV
Production in Tons per Man Day

<i>Year</i>	<i>Anthracite</i>	<i>Bituminous</i>	<i>Year</i>	<i>Anthracite</i>	<i>Bituminous</i>
1890	1.85	2.56	1925	2.12	4.52
1895	2.07	2.90	1930	2.21	5.06
1900	2.40	2.98	1935	2.68	4.50
1905	2.18	3.24	1940	3.02	5.19
1910	2.17	3.46	1945	2.78	5.78
1915	2.19	3.91	1947	2.78	6.42
1920	2.28	4.00	1949	2.87	—

SOURCE: United States Bureau of Mines.

Where mechanical techniques can be applied to mining, costs are greatly reduced, but except in stripping operations, the application of mechanical mining methods has met with great difficulty in the anthracite area because of the geologic structure of the coal deposits. The recent status of mechanical mining is shown in the following table:



This chart records the struggle between improved methods of mining hard coal and the increased difficulty of extraction. Bituminous mining is much easier to mechanize.

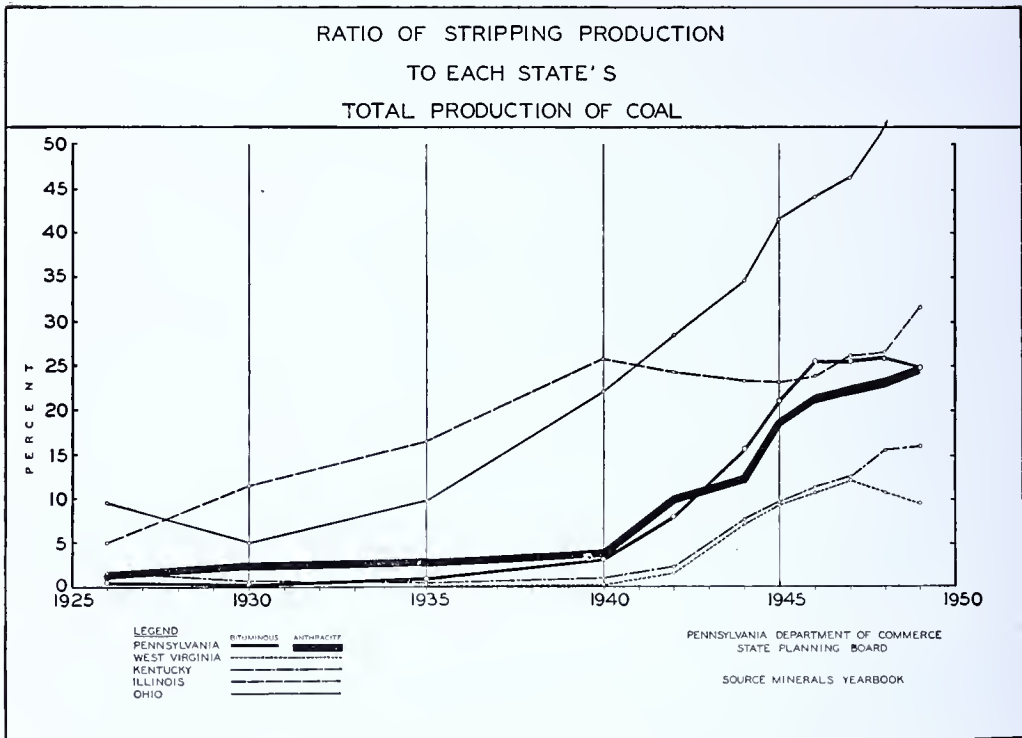
TABLE V
Underground Production—1948

	<i>Anthracite</i>	<i>Bituminous</i>
Loaded Mechanically	42%	64%
Cut by Machines	2.7%	90%

Early mechanical developments in the hard coal mines were aimed at the successful mining of thin beds. Since then, anthracite mines have, where conditions permitted, used equipment designed for metal and bituminous coal mines, but most of the anthracite seams present problems which cannot be solved with conventional equipment.

The U. S. Bureau of Mines has pioneered in the attempt to create new mechanical mining equipment for anthracite. Through independent research and with the assistance of operating companies, new machinery is being developed,¹ but coal cut by machines still represents less than three percent of all deep-mined anthracite.

¹ Anthracite Mechanical Mining Investigation Progress Reports 1 and 2, U. S. Bureau of Mines, Department of the Interior.



The growth of stripping operations has helped to offset the increased difficulty of underground coal mining.

Mechanical loading has made far greater progress than machine cutting in underground operations and offers great possibility for further reduction in mining costs, but perfection of cutting machines suited to conditions in the anthracite mines would also be a factor in increasing output. Experiments made by the U. S. Bureau of Mines with the Eickhoff shearing machine, a German invention, have been encouraging as to the soundness of the principle of the machine and as to the fact that a practical anthracite coal cutter can be designed.

If technological improvements in mining are accompanied by vigorous sales promotion, for which the industry has established an agency in the Anthracite Institute, lower comparative costs of coal to the consumer could be translated into a greater demand for the product which would improve both profits and opportunities for employment.

Stripping, which is capable of almost complete mechanization, has of course been an outstanding development in recent years and has reached to greater depths than were once believed to be practicable, but cannot be counted upon to maintain indefinitely its high percentage of the output of the industry.

The washeries and breakers, which for many years have recovered a large tonnage from the culm banks, will for a long time add substantially to the annual production, but the future of anthracite lies primarily with deep-mined coal and with any improvement possible to be made in the costs of its extraction.

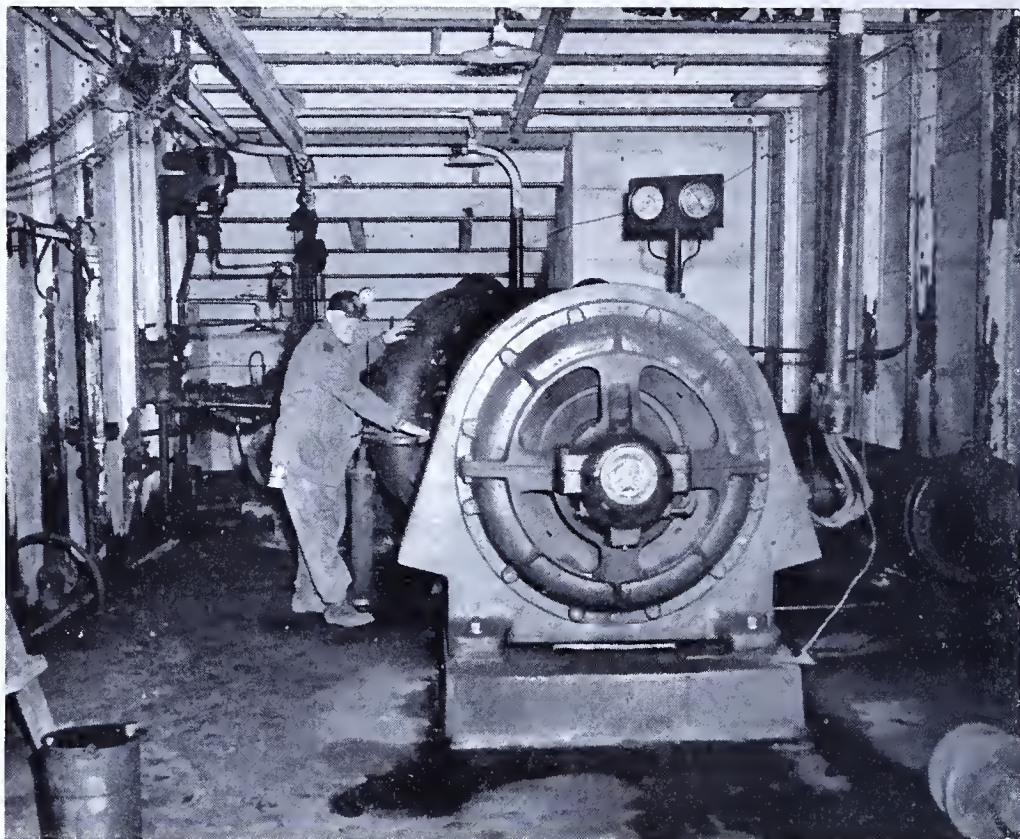
The increasing quantity of water which has had to be removed from the workings has added progressively to the cost of anthracite mining in recent years. During the five years from 1944 to 1948, an average of 19.0 tons of water was pumped from the underground anthracite mines for each ton of coal extracted. In the Northern and Western Middle Fields, the pumping burden was even greater as shown in the following table, and tends to increase each year for all the fields as the mines reach further into the depths of the earth.

TABLE VI
Tons of Water Pumped to Surface
Per Ton of Anthracite Produced Underground
(Average 1944 to 1948)

<i>Field</i>	<i>Tons</i>
Northern	20.8
Eastern Middle	10.8
Western Middle	20.8
Southern	14.2
Region	19.0

SOURCE: Ash and others. Data on Pumping at the Anthracite Mines of Pennsylvania. U. S. Bureau of Mines Report of Investigations, 4700. Sept. 1950.

Although no reliable data are available as to the cost of pumping, an estimate based on a power charge of \$0.01 per kilowatt hour places it at greater than \$0.25 per ton of coal mined assuming interest and amortization charges are extended over a period of twenty years.



The pump room of an anthracite mine. An average of nineteen tons of water must be pumped out for every ton of coal mined.

Interruption of mining operations following a heavy rainfall are not uncommon in the anthracite field. Water equivalent to more than 40 percent of the total precipitation in the anthracite area was pumped from the mines from 1944 to 1948 and reached as high as 89 percent in the Northern Field. Forests which once retained precipitation have been denuded and now provide a surface on which water runs off very rapidly to find its way into the mines through surface cracks and faults in stream beds. Pump capacity is insufficient to meet the peak demands of water infiltration and both employment and equipment are frequently sacrificed.

Perhaps the most serious aspect of the accumulation of water in the anthracite workings is the loss of invaluable energy reserves drowned out by the steady inflow.

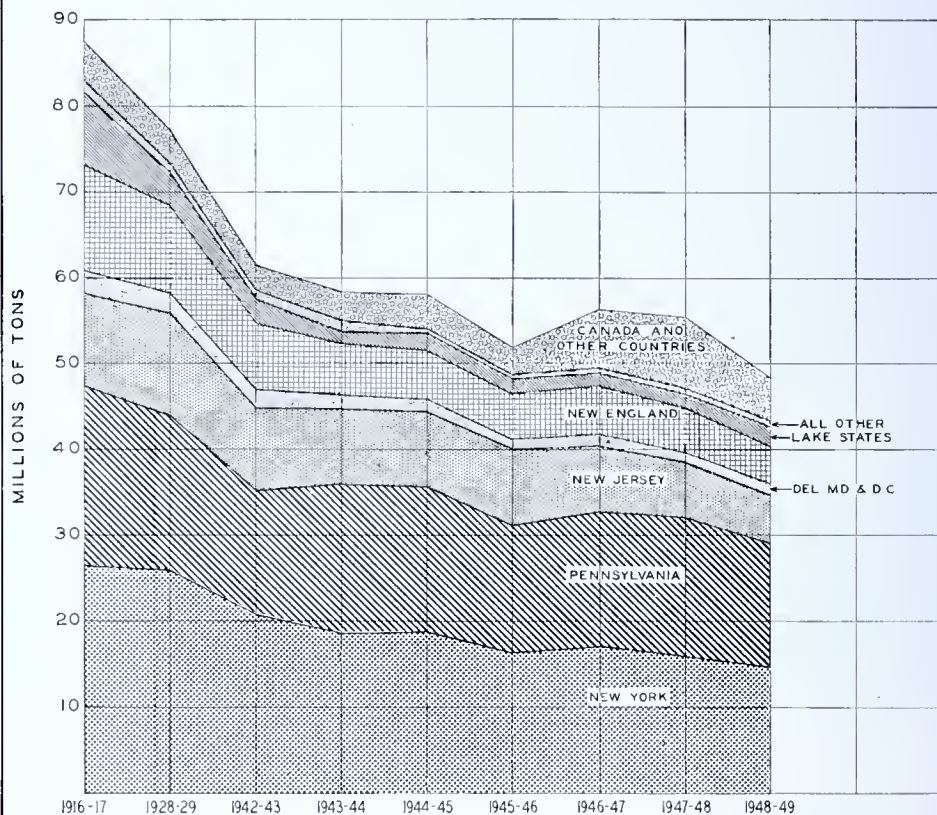
Proposals have been made for the construction of drainage tunnels for the relief of pumping operations and the recovery of drowned coal. The effect of such tunnels requires careful study. Obviously, if this is a public undertaking, the advantages provided should not be discriminatory in favor of one coal field or one group of operations without due consideration of all other operators not relieved of their drainage problem. The effect of a drainage tunnel upon the sub-surface water supply of the area concerned and upon the river basin below the drainage outlet must be carefully and impartially investigated before a considered opinion could be formed as to the merit of any specific project.

It is clearly a counsel of common sense to prevent as much as possible of the surface precipitation from entering the mine workings. Prevention of surface inflow, reforestation of water sheds, the construction of flood control dams and of flumes or impervious channels across breaks and faults in stream beds and the back-filling of strippings to a level which will permit of surface drainage are possible expedients for at least a partial solution of the mine water problem.

The cost of mine drainage, like the cost of holding large coal reserves and the cost of acquiring and maintaining mechanical equipment, is not greatly influenced by the tonnage of production. Any stimulation to hard coal demand would enable these and other fixed items of cost to be distributed over a larger volume and would consequently reduce the production cost of all coal marketed.

DISTRIBUTION OF ANTHRACITE SHIPMENTS BY GEOGRAPHIC AREAS

FOR COAL YEARS 1916-17 1928-29 AND 1942-49



SOURCE - U. S. BUREAU OF MINES

PENNA STATE PLANNING BOARD

Freight Costs

On the average, freight charges represent fifteen percent of retail price, the lowest of all the major cost classifications. But this general average does not reveal the decisive and progressive effect of freight charges in sharply limiting the marketing area for hard coal. At the fringe of the primary market, railroad freight costs represent almost 20 percent of retail price for chestnut, and even more for steam sizes.

TABLE VII

Railroad Freight Rates as a Percentage
of Retail Price and Distance Shipped

ANTHRACITE CHESTNUT—JANUARY 15, 1950

	<i>Retail Price Per Net Ton</i>	<i>R. R. Freight Cost</i>	<i>Percentage Freight Cost</i>	<i>Distance (Miles)</i>
Anthracite Region	\$14.65*	\$0.00	—	—
Philadelphia	19.84	2.75	13.9	130
<i>Approximate Average</i>	<i>20.51</i>	<i>3.10**</i>	<i>15.0</i>	<i>170</i>
New York	21.26	3.84	18.1	180
Boston	22.50	4.41	19.6	456

* Including Trucking Charges.

** Estimated.

Data Source: Pennsylvania Public Utility Commission and
United States Bureau of Labor Statistics.

Upon the difficult and controversial question of whether or not freight rates can be reduced, there appears only one sound stand to be taken. If lower rates, within the margin of handling costs and reasonable profit can result in increased tonnage of hard coal shipments, all three phases of the industry: production, distribution and merchandising, will be benefited. In 1916 our eastern railroads hauled 66,251,258 tons of anthracite. In 1947 total shipments aggregated 48,239,899 tons and in 1949, 35,232,356 tons. The decline between 1916 and 1949 was 31,018,902 tons, or more than 47 percent of the 1916 shipments.

This represents a serious loss in revenue freight and provides a substantial reason for re-examining the rate structure of anthracite carriers.

It is not contended that lowering anthracite freight rates would automatically increase the average haul of the fuel, but it does seem likely that a reduction in freight rates would permit the expansion of the anthracite territory and might provide the groundwork for the rehabilitation of the industry. Certainly, a thorough study of the problem is in order, particularly in light of the fact that truck shipments of hard coal have more than tripled in the past twenty years, as reported by the Pennsylvania Department of Mines, thus further cutting into the railroad market.

The following table compares freight rates for hard and soft coal shipped from the major territories of origin:

TABLE VIII
Coal Freight Rates
COMMODITY RATE BASIS 1947

	<i>Territory of Origin</i>	<i>Average Rate (Cents per Short Line Ton Mile)</i>	<i>Average Haul (Short Line Miles)</i>	<i>Average Freight Cost (Dollars per Ton)</i>
Anthracite . . .	Official	1.43	177	2.53
Bituminous . . .	Official	.83	287	2.38
Bituminous . . .	Southern	.76	325	2.47

SOURCE: Calculated from "Carload Waybill Analyses, 1947. Products of Mines." Interstate Commerce Commission, Washington, D. C., July, 1949. (Based on one percent sample of all audited carload waybills.)

Certain facts are obvious from the foregoing table. Outstanding is the observation that the revenue per ton of coal carried varies only slightly regardless of territory of origin or type of coal hauled. If it has been the purpose of those responsible for railroad rate-making to level the locational advantages of one coal source over another, they have been extremely successful. The implications of this arrangement deserve consideration.

Anthracite and bituminous coal are essentially non-competitive. Anthracite is primarily a domestic fuel while bituminous coal is primarily an industrial fuel. Because of this fact, neither fuel need be protected from the other by manipulation of rates. Obviously the anthracite railroads deserve an adequate return on their operations but it is also obvious that since the last thirty years have witnessed shrinking employment in the hard coal mines and abandonment of valuable anthracite resources, operations under an unfavorable freight rate structure can only accelerate this trend.

When it comes to considering the effective marketing areas, which are related to the average haul, it appears that the railroads have been an important though unwilling factor in limiting the anthracite market.



Settling basins like that shown above help clear our river waters and greatly increase the available supply of small sizes of anthracite.

The Critical Steam Sizes

Except in the event of war or other contingency which would reduce the supplies of oil or gas available for domestic heating, the downward trend of hard coal consumption, interrupted by the period of the Second World War, is almost certain to be renewed unless demand is increased for all sizes of anthracite smaller than pea.

To meet the competition of oil and gas or any other form of modern heating, the anthracite industry must look to automatic equipment that utilizes buckwheat and smaller sizes of anthracite.

In 1949, the net operating profit of five¹ major anthracite mining companies averaged less than 2 per cent² of sales before taxes. These companies represent over one-half of Pennsylvania anthracite production.

During 1949, the average sales realization per ton of all anthracite breaker shipments was \$8.90.³ If we apply the 2 per cent profit to this figure, the calculated cost per ton amounts to \$8.72 but the average cost per ton to the smaller producers probably exceeds this amount.

Since production costs are based on merchantable tonnage, the figure of \$8.72 represents an approximate cost per ton of all sizes of anthracite shipped in 1949.

The average sales realization and the percentage of total shipments in 1949 for each size of anthracite are shown in the following table.

TABLE IX
Average Sales Realization and Percentage by Sizes of
Anthracite Breaker Shipments—1949

	<i>Average Sales Realization</i>	<i>Percentage of Shipments</i>
Domestic		
Lump and Broken	\$11.71	0.2
Egg	11.60	3.2
Stove	11.63	23.2
Chestnut	11.64	26.5
Pea	9.67	7.5
All Domestic Sizes	11.39	60.6
Steam		
Buckwheat No. 1	6.55	13.7
Buckwheat No. 2	5.54	7.9
Buckwheat No. 3	4.31	9.2
Buckwheat No. 4	3.18	4.4
Other	2.87	4.2
All Steam Sizes	5.05	39.4

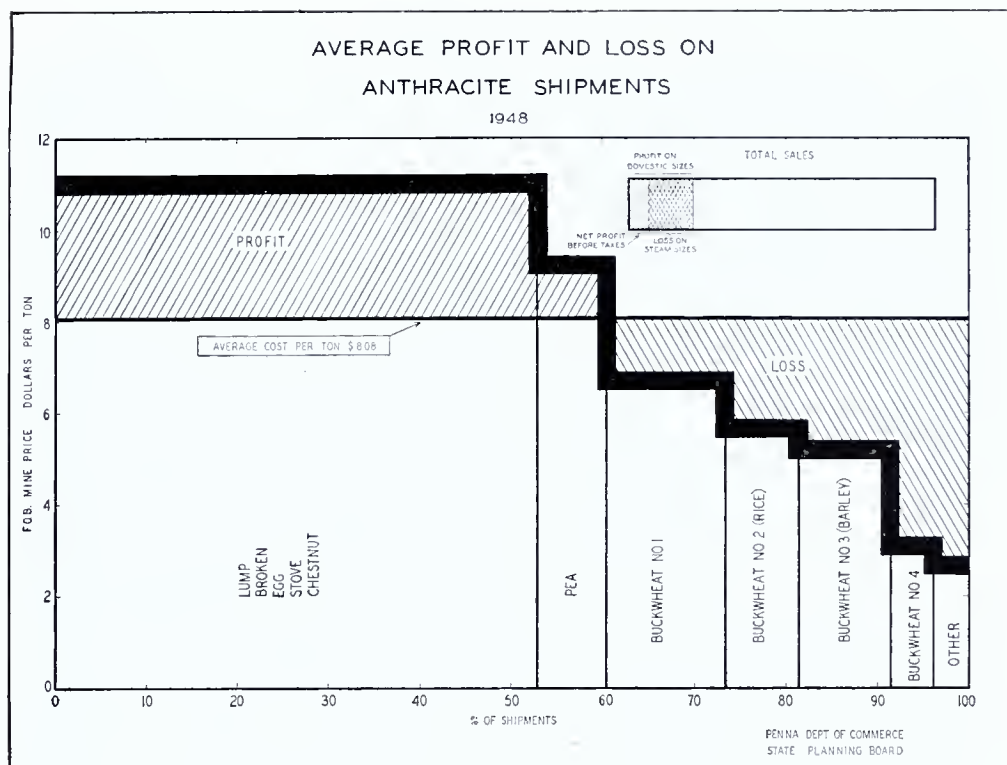
SOURCE: U. S. Bureau of Mines.

It is obvious from the preceding data and the accompanying diagram that all sizes of anthracite smaller than pea are sold at a loss to the producer and absorb a large portion of the profit made on the domestic sizes, so that many producers report a net loss on operations even in normal years.

¹ The Philadelphia and Reading Coal and Iron Company, Glen Alden Coal Company, the Hudson Coal Company, Lehigh Navigation Coal Company, Inc., and Lehigh Valley Coal Corporation.

² Calculated from Moody's Manual of Investments, 1949.

³ U. S. Bureau of Mines.



Anthracite steam sizes are sold below the cost of production.
1949 Data showed a similar profit-loss distribution.

The lack of a market for the steam sizes of anthracite is one of the greatest obstacles in the way of appreciably lowering production costs. It is estimated by R. C. Johnson, Vice President-Research, Anthracite Institute, that about six million tons of silt are produced each year. Much of that tonnage, along with large quantities of buckwheat, Sizes No. 1 through No. 5, never finds its way to the market, because of lack of demand. Nevertheless, a ton of unmerchantable coal incurs the same cost of production as a ton of coal delivered to the consumer's bin.

The calculation of production cost, previously presented, is based on tonnage sold. If more of the coal actually produced could be marketed, mining costs could be distributed over a larger tonnage and unit costs consequently reduced. Profits would naturally improve, and the ability of anthracite to meet competition would be greatly strengthened.

In the mining of anthracite, breakage and crushing of coal is a natural phenomenon. The amount of small size coal produced will depend on the slope of the seam, the depth of the workings, the structure of the overbody and the hardness of the coal.

Because of their Geological structure, the mines of the Schuylkill Region which contains the bulk of the anthracite reserves, tend to produce a larger percentage of steam sizes than either the Wyoming or Lehigh Regions.

TABLE X
Percentage by Sizes of Anthracite
BREAKER SHIPMENTS—1949

<i>Region</i>	<i>Domestic Sizes</i>	<i>Steam Sizes</i>
Wyoming	68.8	31.2
Lehigh	55.1	44.9
Schuylkill	51.0	49.0
Weighted Average	59.8	40.2

SOURCE: U. S. Bureau of Mines.

Approximately 80 percent of the Pennsylvania anthracite reserves are located in the Schuylkill region. Since the production of steam size coal in that region accounts for a larger segment of its total production than for the industry as a whole, the demand for these sizes is a critical factor in the successful operation of mines in the southern field.

A large portion of the unmined Schuylkill reserves are deeply situated and pose problems of extraction which can be solved only at a higher production cost than is presently profitable. These reserves are badly crushed and if ever mined will yield over 50 percent steam size anthracite.

The ultimate utilization of the great storehouses of energy in the Schuylkill region presents a problem of conservation to which business enterprise can find a solution only by expanding the market for the smaller sizes of hard coal.



Automatic damper controls greatly increase the convenience and efficiency of hand-fired anthracite furnaces.

EXPANDING THE DOMESTIC MARKET

As an element of consumer cost, retailing is, on the average, second only to mining. Although very little reliable data are available as to the costs of coal distribution, it has been definitely established that many general retailing practices can be changed to reduce costs and at the same time improve customer satisfaction.

Considerable progress has been made in retailing anthracite, until today many coal dealers provide their customers with a variety of services unheard of a generation ago.

There are obviously two advantages in providing such services; the possibility of reducing costs both for the consumer and the coal dealer and a greatly added satisfaction in the use of anthracite, which is so necessary to the expansion of the industry and of the dealer's own list of customers.

Anthracite dealers must sell on an increasing scale a *heating service* rather than just a commodity if consumer demand for automatic or nearly-automatic heating is to be met.

One might well conclude from the progress made in the popularization of oil and gas burning equipment that the attention of the anthracite industry from now on should be concentrated solely on automatic firing. There is, however, no justification for such a conclusion. Millions of householders within the anthracite area are today users of equipment in which the larger sizes of coal are fired by hand. Such equipment represents the lowest initial cost of any central heating apparatus on the market and the lowest rate of depreciation. The hand-fired coal furnace is today more capable of satisfactory performance than ever in the past. A certain amount of labor is involved which is not objectionable to many in comparison with the savings effected, and some inconvenience connected with hand-firing can readily be eliminated.

Furnace bases have been enlarged to promote the use of standard metal bushel baskets as ash containers. Thermostatic draft regulation is incorporated in many furnaces of modern design. Both the appearance and the efficiency of hand-fired equipment have been greatly improved by the enclosure of furnaces in insulating jackets. Electric furnace draft control with or without clockwork regulating devices can be adjusted to any desired interior temperature.

Over the long term, however, it seems evident that the future of anthracite in competition with fuel oil or with any other modern form of domestic heating lies in mechanical firing methods which will make home heating practically automatic. Every effort must be made to make the use of hand-fired hard coal so attractive to its present

consumers that no negativeness toward anthracite will exist, if or when they turn to automatic equipment.

Many anthracite dealers are finding it profitable to devote greater energy to the merchandising of automatic equipment.

This can be accomplished through cooperative agreements between fuel dealers and heating contractors with service to the consumer as the keynote of such agreements. Whether the coal dealer performs his own servicing or subcontracts to a heating specialist, as much attention should be devoted to the coal bin and the heating equipment as is devoted to the taking of fuel orders.

To compete with oil and gas in the automatic heating market, anthracite must offer comparable services. The fuel dealer who wishes to extend his coal sales might make available to his customers the following conveniences:

1. *Ash Removal Service*

At an added cost on the delivered price of the coal, the customer is relieved of the task of carrying ashes. In areas where ash pit construction is economical, the dealer may service his customers with vacuumatic removal equipment. Otherwise, ash containers can be used and a regular route developed to replace filled ash cans with empty ones. Even at a nominal cost to the consumer, this service is profitable, since it serves as fill-in-work for the dealer, and utilizes otherwise idle equipment.

2. *Degree-Day Delivery*

By making a simple calculation based on outside temperatures in his locality, the dealer is able to anticipate his customers' needs for fuel. Therefore, he can contract to supply all fuel required in a heating season and to deliver the coal when needed without reminders from the householder. In this way, the householder is relieved of the responsibility of watching his coal bin, and the dealer is assured of a customer for the full season. The dealer also can schedule his deliveries and is not burdened by peak demands caused by a sudden cold wave. Degree-day

delivery, in conjunction with ash removal services, enables the maximum utilization of delivery equipment.

3. *Annual Service and Parts Contracts*

By acting as an insurer for all service and parts required for an individual heating unit, the dealer is able to provide security for his customers and for himself. Each customer under the plan pays a stipulated annual amount to cover all labor and parts required to maintain his equipment at greatest efficiency. The dealer will, in addition, provide annual reconditioning of the heating unit. Such a plan distributes the risk of equipment failures to all consumers and the cost of repairs and maintenance is definite and assured. To the dealer, the income from his service department is likewise assured.

4. *Budget Payments for Coal Purchases*

If the dealer provides budget payments, there is incentive for the householder to load his bin at low summer prices, and at a time when delivery equipment is not fully used. Delivery costs are lower than for ton-by-ton purchases and demand can be leveled throughout the year.

That these services can be profitable and can increase the tonnage sold is evidenced by numerous case histories.

One dealer claims his business was quadrupled in a few years as a result of instituting ash removal and other services.

Another dealer with ash removal, budget selling, and degree-day delivery increased his tonnage from 2,500 to 38,000 in fourteen years in a town of 29,000 population.

A dealer in a town of only 16,000 was able to increase his tonnage from 4,000 to 15,000 in 20 years.

It is only fair to say that these dealers were in the equipment business, and that much of their increased tonnage was directly derived from the sale of stoker units. Each reports that dollar profit per ton on steam sizes is equal to or greater than profit on domestic sizes, and that the equipment phase of their business carries itself and produces an added source of profit.

The services mentioned above are particularly attractive to the "automatic" householder, but equal appeal must be provided for the consumer of hand-fired domestic sizes, if his use of anthracite is to be continued. He should be informed as to the approved devices available for increasing the efficiency of his home heating plant, and that at every level of income. Such devices, beginning with simple automatic chimney draft controls adaptable to kitchen ranges, space heaters and furnaces, decrease the attention needed to maintain an even indoor temperature. Simple clock-operated devices eliminate the problem of morning cold in hand-fired systems. More elaborate and efficient electrically operated thermostatic controls provide the hand-fired heating plant with the maximum thermal efficiency. The cost of none of these devices is comparable to that of automatic feeders for any type of fuel, yet they provide means, within every price range, by which the satisfaction of anthracite users with their fuel and the likelihood of conversion to automatic anthracite may be increased.

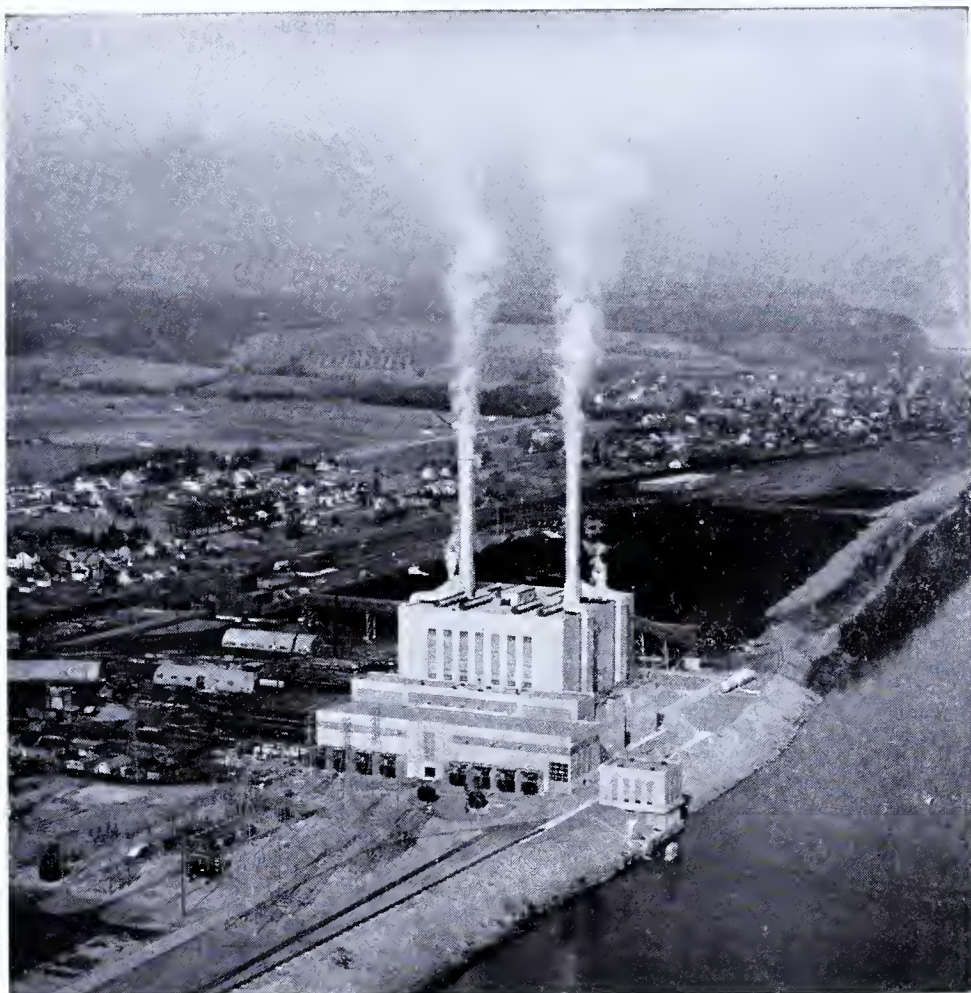
Even if each anthracite dealer offered all the customer conveniences previously discussed, he would not be geared to meet modern competition unless he was backed by sound advertising.

Recognizing this, in 1936, a group of anthracite producers set out to re-establish public acceptance of hard coal. In that year they launched an anthracite promotion campaign through the newly formed Anthracite Industries, now Anthracite Institute. That consumers were receptive to the advertising is shown in the leveling off of the downward trend in hard coal production since the campaign was initiated.

Anthracite Institute is currently, sponsoring the largest program in its history, with producers contributing over \$600,000 for research and field representatives and over \$1,000,000 for advertising, merchandising and publicity. Matching this, individual producers are spending more than \$1,500,000 on brand advertising and promotion.

It is the coal dealer, however, who provides the effective key to an expanding tonnage. He is the only direct link

with the consumer. He has the best chance to utilize this close association for carrying on the excellent promotional campaign of the other division of the industry. He can offer a product of merit and provide a highly satisfactory heating service. Neither producer nor equipment manufacturer can directly offer heating service to an individual consumer, and sales cannot be made without such a presentation. Personal calls, radio advertising, newspaper advertising, direct mail advertising and heat displays are some of the devices at the dealer's disposal to bring his service to the attention of the consumer. In an integrated program for merchandising anthracite, the function of the retailer is clear, for he is the only one who can sell the services which will enable anthracite to satisfy each consumer's individual need.



An anthracite burning power plant.

EXPANDING THE INDUSTRIAL MARKET

Despite declines in industrial use, the variety of fuel and non-fuel uses of anthracite and its products has lately been extended and it may very well be that the efforts of many agencies to revive the industrial possibilities of hard coal will be an important factor in the recovery of the industry.

The unique position of anthracite in the economy of our northeastern states has been pointed out. The demand for this fuel is largely non-industrial and is not adversely affected by such periods of high defense activity as prevailed during the First and Second World Wars and seem likely to recur in the immediate future.

Notwithstanding this fact, anthracite does have important industrial possibilities and within its area could well provide the basic raw material for important production in the chemical and metallurgical fields and in the generation of both producer gas and electrical energy.

These possibilities, for which the raw materials are available and largely unused, could be developed, not to the detriment but to the advantage of anthracite's primary function, that of providing heating for the houses, apartments and factories of the northeastern states.

The steam sizes of anthracite were largely unsalable during the period when hard coal was used chiefly in hand-fired domestic furnaces. There is consequently a large accumulation of burnable carbon in the culm banks of the anthracite area and also a considerable accumulation in the beds of the Susquehanna, Lehigh and Schuylkill Rivers.

Buckwheat No. 1 and 2, the largest of the steam sizes, are now in demand for use in domestic coal stokers but are sold well below the market price of the so-called domestic sizes.

Since hauling costs are figured largely on a tonnage basis, freight costs represent a much higher percentage of the sales price of the steam sizes than of the domestic sizes so that the industrial market is sharply limited for fine size anthracite in competition with bituminous coal or residual fuel oil.

In addition, there is the problem of handling these sizes in cold weather when freezing often converts the contents of a hopper car into a solid mass which can be broken up only with great difficulty.

These factors make it highly probable that the industrial use of the steam sizes will always be limited to points in the anthracite region where hauling costs are at a minimum. Yet it can safely be said that unless such industrial uses are developed through the efforts of the coal companies or the enterprise of the business interests of the anthracite area, one of the principal problems of the industry will not be solved.



These dark Pennsylvania hills of culm are the greatest evidences of human energy ever piled up in the history of the world.

On the other hand, we are presented with the fact that a tremendous store of fuel energy is available and that it is today largely a waste product. At last 150 million tons of silt are now above ground in the anthracite culm banks. In addition, several million tons of bone coal are produced every year and dumped on the rock banks. This coal, which consists of anthracite intermingled with slate deposits, contains approximately 70 per cent of fixed carbon. Only in a nation prodigal of its energy resources would such burnable material be allowed to go to waste.

It is clear that the usable energy in these waste products of the anthracite mines represents the principal losses in the production processes of the industry. If these losses could be turned to profit or even cancelled out, a great forward step would be taken in restoring anthracite to its proper place in the American fuel market.

Anthracite Fines in Electric Power Generation

Perhaps the most important actual and potential use for the steam sizes is in the generation of electricity. In a paper presented at the Sixth Annual Anthracite Conference in 1948, D. D. Shulz described the operation of a direct-fired pulverized anthracite unit installed at the Suburban Plant of the Scranton Electric Company. The completely integrated unit, including boiler, turbine, generator and auxiliaries, is capable of 35,000 KW output at boiler efficiencies exceeding 85 per cent with low cost No. 4 and No. 5 buckwheat.

The feasibility of using anthracite fines for power generation has been further demonstrated by the Pennsylvania Power and Light Company. In its new Sunbury plant, on the west bank of the Susquehanna River, the company has installed the four largest anthracite burning units in the world. These steam generators are fired with pulverized hard coal and supply power for two 75,000 KW turbine-generators. Over \$40 million was required for the initial installation of 150,000 KW capacity, and present plans call for a total of six turbine-generators with a combined capacity of 550,000 KW. With a 12,100 BTU consumption per KW, the plant uses only 1.1 lb. of 11,000 BTU coal per KW output. Only this marked economy of operation could justify the tremendous investment involved. With such a strong evidence of anthracite's suitability for power generation, possibilities for more extensive application should be explored throughout the anthracite marketing area.

Metallurgical Uses of Anthracite Fines

Since the principal problem dealt with in this section of the report is the useful disposal of anthracite's silt and fines no extended mention will be made of such industrial uses of hard coal as require the larger sizes. Under particular conditions and in operations close to the mine mouth certain recognized advantages of anthracite in iron foundry cupolas may make the use of egg and broken

sizes desirable and economically feasible. Many important demonstrations of that fact have been made in such experimental operations as those conducted by J. F. K. Brown of the Hudson Coal Company, and continued by C. C. Wright and W. J. Reagan of The Pennsylvania State College under the sponsorship of the Pennsylvania Department of Mines and the Anthracite Institute. The principal problem, however, is the development of adequate uses and hence of a profitable demand for Buckwheat Nos. 4 and 5 and silt.

One important field for further investigation is indicated by the use of the steam grades of anthracite for sintering the magnetite ores of the Adirondack region of New York and the Cornwall deposits of Pennsylvania. Magnetic concentrates from those important eastern iron ores are so fine that they cannot be economically smelted in iron blast furnaces. In the sintering process, the finely ground iron ore is, in effect, roasted in pans after admixture with approximately six per cent of coal. This process forms the ore into coherent but porous masses which can be fed into a blast furnace. It has been found that low ash anthracite of the No. 4 and No. 5 buckwheat sizes is an excellent sintering fuel. The proximity of the anthracite deposits to the principal sources of eastern magnetite provides an important outlet for this grade of fine coal. The possibility of further development of the sintering process using anthracite in connection with lower grades of eastern ore is well worth investigating on a long term basis.

Other metallurgical uses of hard coal have developed indirectly through improvement in the yield and strength of coke by admixture of a small percentage of anthracite fines with bituminous coal charged into the ovens. The fine grades of hard coal are also the standard fuel in the smelting of zinc.

Anthracite Fines in Gas Generation

Although extensive experiments and practical demonstrations have been made as to the value of anthracite in the large sizes for the generation of both carbureted and non-carbureted water gas, comparatively little attention

has been paid to the possibilities of the fine sizes when used close to the mines for the generation of gases from which ammonia, methanol or gasoline could be derived. It seems obvious that, if such a cycle of production could be established in the anthracite area, several important ends would be attained. The products of such gases would provide raw material for many derivative industries. The use of silt, rice or barley coal for such an industrially valuable purpose would provide a needed balance of demand among the anthracite sizes and would relieve the strain which falls upon our oil and natural gas supplies in a period of national emergency.

As a source of water gas, anthracite has proved its practicability in the municipal gas plants at Carlisle and Pottsville, Pennsylvania, and has been shown to provide greater heat storing capacity than competing fuels.

Producer gas is largely used as an inexpensive source of heat for industrial processes. When generated with the steam sizes of anthracite, producer gas has proved extremely profitable for use as a blanketing gas when annealing high grade carbon steels, where its low hydrocarbon content makes it especially useful. In kiln installations at Trenton, at Baltimore, at Norris under T. V. A., as well as in other industrial centers, anthracite producer gas has proved more economical and more satisfactory than other fuels. The types of production so far affording practical proof of the peculiar advantages of anthracite gas are the annealing of steel castings, the heat treating and drawing of metals, the finishing of fine steel objects such as watch and clock springs, the heating of biscuit baking ovens, and of ceramic kilns, and canning operations. Industries of such types are therefore peculiarly suited to the anthracite area. The generation of producer gas is one of the most promising present day developments for the disposal of the steam sizes and for the development of new products in the anthracite counties, as anthracite gas provides the cheapest soft and noncarbonizing heat now available to industry. In 1946, nearly five million tons of coke were consumed in the generation of producer and water gas according to the records of the United States Bureau of

Mines. The average value per ton of all coke used for gas production exceeded \$19.00 per ton, as compared with the price of \$2.50 per ton for anthracite fines at the mine.

TABLE XI
Typical Composition and Heating Values

	SELECTED FUEL GASES		
	<i>Bituminous Producer Gas</i> ¹	<i>Anthracite Producer Gas</i> ¹	<i>Anthracite Producer Gas (Oxygen Gasifi- cation Barley Anthracite)</i> ²
Percent by Volume:			
Carbon Monoxide	27.0	24.0	42.40
Carbon Dioxide	4.5	7.5	17.20
Hydrogen	14.0	16.5	37.65
Nitrogen	50.9	50.2	1.80
Oxygen	0.6	0.6	0.20
Methane	3.0	1.2	0.75
Illuminants	—	—	—
Gross Heating Value:			
B.T.U.'s per Cubic Foot.	150	134	266

Until very recent years, comparatively little attention has been paid to the possibilities of a gas from solid fuels suitable for use as a basis for synthetic production of essential industrial chemicals, although it has been realized that an important source of carbon and heat energy did exist in the least wanted products of the anthracite mines.

Prior to and during the period of World War II, attention was turned to techniques for the gasification of solid fuels in the presence of oxygen. The Germans made use of such a process in their frantic search for sources of motor fuel and other essential hydrocarbons.

Both in the Provinces of Ontario and British Columbia in the Dominion of Canada, pilot plants have been experimenting with the oxygen gasification of coke and bituminous coal. The application of this process to the finer sizes of anthracite has been made the subject of experimental investigation and trial runs at Trail, B. C., by the Division of Fuel Technology of the Pennsylvania State College, under the sponsorship of Anthracite Institute.

SOURCES: (1) Perry, J. H. Chemical Engineers Handbook, 2nd Edition P 2363 from "Combustion," 2nd Edition. American Gas Association, 1926.
(2) Wright, C. C., and Newman, L. L. The Oxygen Gasification of Anthracite in the Wellman-Galusha Producer, School of Mineral Industries, The Pennsylvania State College, 1947.

In these experimental runs using several hundred tons of rice and barley anthracite, the following important conclusions were reached:

"1. Rice size anthracite can be satisfactorily gasified in stationary fuel beds using oxygen and steam to yield high-quality gas suitable for use in ammonia, methanol, or gasoline synthesis at gasification rates at least 100 percent higher than gasification rates for the same size fuel in the same producer when air and steam are used.

"2. The composition of the raw gas produced by the oxygen gasification of rice anthracite approached more closely the composition desired in purified synthesis gas than that reported for operations with large coke. Inert content was about the same while tars and condensable residues were not present in detectable amounts.

"3. Oxygen consumption per MCF of raw gas and per pound of fuel gasified was appreciably lower for rice size coal and slightly lower for barley coal than for large size coke at comparable ratings."

It is obvious that possibilities so important for both defense and civilian industry deserve further investigation.

As this report is being concluded, the possibilities of war seem ominous. Whether or not the present localized conflict will spread to other portions of the world, the fact still remains that the issues facing our nation are so sharply drawn that the prospects of peace seem remote indeed for many years to come.

Although these forebodings may never be realized, the time has very obviously come when no source of American industrial strength can safely be neglected. If hard coal can provide the raw materials for ammonia and methanol synthesis and at the same time supply heat for the millions of the homes in the eastern part of our country where much, if not most, of the great industrial work must be done, then anthracite has ahead of it a period of growth and revival which may have a profound effect upon the

people of at least five Pennsylvania counties and upon the total industrial outlook of the State.

Experience has proved, however, that if the anthracite producers do not energetically cooperate to develop these possibilities, a great chance may be lost for the revival of anthracite as an industrial fuel and for its expanded use in domestic heating.

OPPORTUNITIES IN THE ANTHRACITE AREA

Because of the historic fact that population and employment in the anthracite area were based on the production of hard coal, industrial development in other directions began there at a much later date than is true in most sections of the state. Partly because of the abundance of female labor, the accessibility of the important markets of Pennsylvania, New York and New England and the ample supply of fuel and electric power, the anthracite area has, nevertheless, become one of the nation's most important textile centers. It is America's greatest producer of lace goods and until the time of the Second World War was the chief center of the silk throwing industry. It has a large production of dress goods and work clothes. Despite this record and the fact that the metal and chemical industries have shown outstanding growth in the past several years, the industrial possibilities of the area are largely unexplored.

A local market of over 1,000,000 people can support consumer and durable goods industries of many kinds. With a haul of less than 500 miles, some ninety million people can be reached.

Skilled labor, fuel and water are plentiful. Transportation facilities are highly developed and essential raw materials for many industries are easily obtainable.

The people of the anthracite area are traditionally industrious and have developed some of America's most outstanding examples of local and community enterprise.

The Scranton plan for the financing and encouragement of new industry has had a success which has attracted national attention. Wilkes-Barre has been active in the de-

velopment of new industries through its privately financed Wyoming Valley Industrial Building Fund.

Hazleton has had unusual success in securing new industries through the construction of buildings for large and small manufactures. Five communities have combined to form the Panther Valley Industrial Association.

Pottsville, Shenandoah, Pittston and many other communities, including the village of Mildred in Sullivan County, have developed unusual and successful programs of self-help.

The resources of the anthracite region, its location in the heart of the nation's richest market and the great energy of its people are favorable for the development of industries which consume commercial sizes of anthracite. Such development would stabilize the economy of the anthracite area through diversification of its industry and at the same time strengthen the position of hard coal in our State and National economy.

Acknowledgments are due to the Anthracite Institute for supplying many of the photographs used to illustrate this issue, to the Department of Internal Affairs for supplying the cut of the Anthracite burning electric generating plant shown on Page 39, and to the Secretary of Mines and members of the Anthracite Committee for reviewing the text of this issue.

SELECTED PUBLICATIONS OF THE PENNSYLVANIA STATE PLANNING BOARD

Publication
No.

- *1—Preliminary Report. 682 pages. 152 charts, December, 1934.
- *10—Drainage Basin Study. 3 vols., 611 pages, 1937.
- 15—Recent Industrial Trends and New Employment Opportunities in Pennsylvania, 1944.
- 16—Retail Trade in Pennsylvania, 1946.
- 17—Industrial Utility of Water in Pennsylvania. Chemical Character of Surface Water, 1944 to 1946, 1947.
- 18—The Pennsylvania Zoning Primer (Revised), 1948.
- 19—Local Powers for Community Development, 1948.
- 21—Planning and Zoning Powers and Procedures in Pennsylvania, 1949. Vol. 1. (Townships of the Second Class, Counties, Regions.)
- 22—Planning and Zoning Powers and Procedures in Pennsylvania, 1950. Vol. 2. (Cities, Boroughs, First Class Townships.)
- 23—A Pennsylvania Recreation Manual. Revised Edition, 1950.

A limited number of those listed are available for distribution until the present supply is exhausted. Those marked with an asterisk are now out of print but may be seen in representative public libraries.

The following issues of **Pennsylvania Planning** are still available.

- Local Tax Rates, May-June, 1940.
- Community Self-Appraisal (Revised Edition), April, 1942.
- Population, October, 1942.
- Handicrafts in Post-War Planning, May, 1943.
- Plastics, July, 1943.
- Air Photographs, February, 1944.
- Light Metals and Stainless Steel, August, 1944.
- Topographic Mapping Needs, February, 1945. (For limited technical distribution.)
- Community Action for Local Self Development, July, 1945.
- Conservation, August, 1945.
- Forest Resources, November, 1946.
- Soil Conservation, September, 1947.
- Minerals Conservation, December, 1948.
- Know Your Pennsylvania, September, 1949.
- Comparative County Data, August, 1950.

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SEPTEMBER 1952

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Know Your Pennsylvania



A Brief Survey of the Resources
and Achievements of One
American State



Revised Edition

State Planning Board
Pennsylvania Department of Commerce
Harrisburg, 1952



This is Pennsylvania

Pennsylvania Planning

To inform those who
are interested and
to interest others.

Issued by

PENNSYLVANIA DEPARTMENT OF COMMERCE
STATE PLANNING BOARD
Harrisburg

Vol. 11

SEPTEMBER, 1952

No. 2

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Where life is good

"Know Your Pennsylvania" was originally issued in September 1949. This revised edition has been made necessary by a continuous demand for information concerning the structure of our State's government, the sources of our wealth, our scenic and historic attractions, and the facilities for good living to be found within the 45,000 square miles of Pennsylvania's area. Much of the data has been derived from reports of the Pennsylvania Departments of Internal Affairs, Agriculture, Forests and Waters, Mines, Public Instruction, Highways, Banking, Insurance, Revenue, the Pennsylvania Public Utility Commission, the U. S. Census and the Federal Power Commission.

Introduction

It is probable that in all the world no other area of 45,000 square miles equals Pennsylvania in the wealth of its resources and the range of its products. Where else can be found an industrial pattern so rich and varied as to lead a whole hemisphere in the production of steel and pig iron on one hand, and of delicate lace curtains and table cloths on the other? What other region of the earth produces, at the same time, more cement and more umbrellas, more zinc and more shirts, more glass, more coke and coal-tar products and more cigars—more of all of these than any other state in the Nation, or any nation but our own in the Western World? Ninety-nine percent of all American anthracite comes from Pennsylvania and the Keystone State is also one of the two greatest producers of bituminous coal.

Hearing these facts about Pennsylvania a stranger might well imagine the whole area of this State to be nothing but a long line of factory chimneys. But one would also have to tell him that Pennsylvania contains 15,000,000 acres of forest and that more than 3,200,000 acres of that woodland are owned by the public and are devoted to wild life, flood control, and public recreation.

But if that is so, between your industries and your forests, the stranger would conclude, there can be nothing else. You must depend for your food supply on other places. But that would be far from true for, in addition to all its great and varied industries and its many million acres of wild land, Pennsylvania is one of America's great farming states. It produces more steel, but also grows more cigar leaf tobacco. It quarries more stone, but also

harvests more buckwheat. It ships and receives a greater tonnage of commodities than any State in the Union. It is among the Nation's greatest shipbuilders. It possesses one of our Country's busiest seaports, and the World's oldest continuously productive oil field. It also stands among the Nation's great producers of potatoes and apples.

It is the only State with outlets within its own area to the Atlantic, the Great Lakes, and to the Mississippi and Gulf of Mexico. Its highways would reach four times around the Earth, and include the finest protected roadway on the Continent.

With all this teeming industry and modern transportation the State has also 9,500 miles of fishing streams, and every year from its woodlands, 850,000 hunters bring home small game by the millions, an average of 50,000 deer and from 200 to 600 bear.

The enterprise and ability of Pennsylvania men and women have had a profound effect on the history of the modern world. Both John Fitch and Robert Fulton, the inventors of the steam boat, were Pennsylvanians. The first commercial oil well in the world was drilled by Edwin Drake on Pennsylvania soil. The railroad air-brake was the invention of a Pennsylvanian, George Westinghouse. Robert E. Peary, the discoverer of the North Pole, was born at Cresson, near Altoona.

Pennsylvania has America's second largest civilian population and its largest rural population. In the period following the Second World War, the Census shows it leading all other states in the expansion of plant and plant facilities and it is first in the Nation in approved construction for the national defense.

In war or in peace Pennsylvania is a land of inexhaustible energy and variety, a vital factor in American progress and success.

KNOW YOUR PENNSYLVANIA

I

Topography, Climate, and Land Use

The ridges and the valleys of the Appalachian Mountain System, curving across Pennsylvania from northeast to southwest, divide the State into four fairly distinct topographic and climatic areas.

The eastern ridges, or Blue Ridge Mountains, once among the tallest mountain ranges in the World and almost the oldest, mark the western limit of the *coastal climatic belt* of usually moderate temperatures and ample rainfall.

Within this belt temperatures as high as 90 degrees occur on an average of only 15 days during a summer season. Temperatures of zero or lower at Philadelphia occur on an average of one winter in four, and at Harrisburg, of one winter in three. The growing season in this belt averages 170 to 200 days. The average seasonal snowfall is about 30 inches, and the rainfall ranges from 38 to 46 inches.

The *mountain belt*, which includes both the Blue Ridge and the Allegheny Systems, occupies the center of the State, an area consisting of ridges and valleys toward the southeast, and to the west of taller broken plateaus, which reach their highest point in Somerset County. This section has somewhat greater temperature extremes than the southeastern part of the State with an annual precipitation averaging three to four inches more, and a much more

REF

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variable winter snowfall which ranges from 88 inches near Somerset to about 37 inches in Huntingdon, Mifflin, and Juniata Counties, the ridge and valley area. The growing season is longest in the Susquehanna Valley where it averages 165 days, and shortest in Schuylkill and Carbon Counties and on the Pocono Plateau where it averages less than 130 days.

The *northern counties* have an average elevation greater than that of the valley region south of them, with considerably lower minimum temperatures in the winter. The daily average temperature ranges from 22 to 26 degrees in midwinter, and from 66 to 70 degrees in midsummer. The growing season is less than 130 days throughout most of the area, but in Erie County increases to about 175 days along the Lake shore. The seasonal snowfall averages about 54 inches, and fields are normally snow-covered three-quarters of the time during the winter. These northern counties are our most heavily forested area.

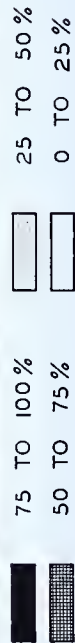
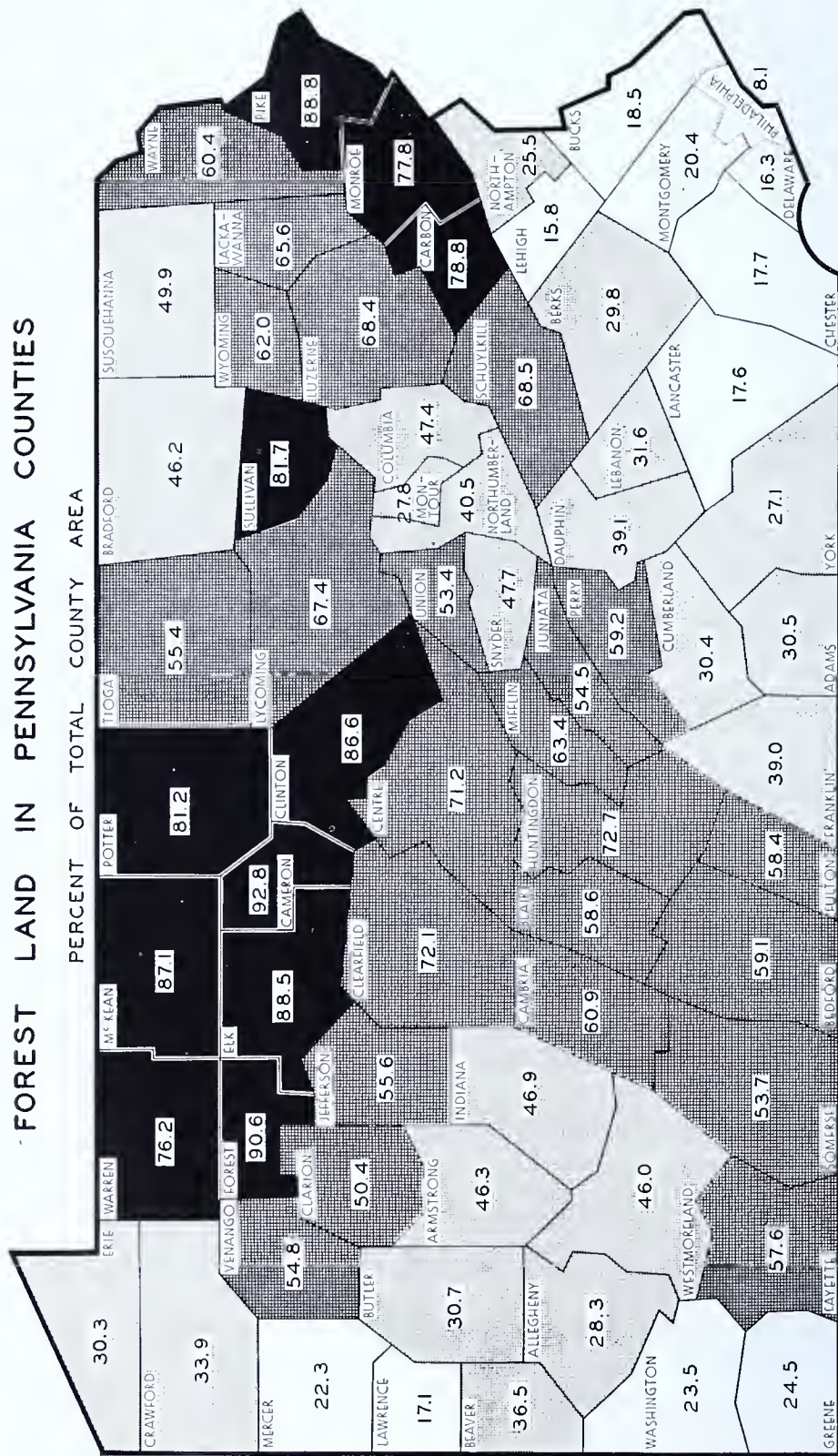
The *western* section of Pennsylvania within the Ohio basin has more changeable temperatures and more frequent rainfall or snowfall than other parts of the State. The growing season is variable, ranging between 140 and 175 days. While the rainfall approximates the State's average, it usually occurs in smaller amounts at more frequent intervals. The average snowfall is about 50 inches.

More than 52 percent of the State's area is in forest land. In Cameron County almost 93 percent is forested. Forest County has slightly over 90 percent. Pike, Elk, McKean, Clinton, Sullivan, and Potter Counties have over 80 percent. Thirty-four counties of the State have more than 50 percent of their area in forest, and only six counties have less than 20 percent.

More than one thousand square miles of lakes and rivers lie within or are under the control of the Commonwealth. This includes 735 square miles of Lake Erie, and 288 square miles of inland waters. While there are no very large inland lakes in Pennsylvania, a generous number of smaller ones are scattered over the northeastern and

FOREST LAND IN PENNSYLVANIA COUNTIES

PERCENT OF TOTAL COUNTY AREA



SOURCE: PENNA. DEPARTMENT OF FORESTS & WATERS.

PENNA. DEPARTMENT OF COMMERCE
STATE PLANNING BOARD

More than half of the State is forest land

northwestern counties. Some of the best known are Pymatuning and Conneaut in the northwest, and Wallenpau-pack, Harvey's Lake and Eagles Mere in the northeast.

Pennsylvania's average annual rainfall of 42 inches is both the source of our agricultural prosperity and the cause at times of serious flood danger and of constant soil erosion. In the average year the total volume of rainfall weighs more than 138 billion tons. An average of more than 3 million tons falls annually on every square mile, or more than 4,700 tons on every acre. Most of this great volume of water flows out of Pennsylvania toward the sea through three great river systems—that of the Delaware and Schuylkill on the east, of the Susquehanna in the central valley, and of the Monongahela, the Allegheny, and the Ohio in the west. There are other smaller drainage systems flowing both to the north and to the south, so that Pennsylvania's rainfall has probably more diverse outlets to the sea than those of any other State.

It is discharged down the Ohio into the Mississippi and thence to the Gulf of Mexico, into Lake Erie, into Lake Ontario, and through those lakes into the Gulf of St. Lawrence, into the Delaware Bay, and into the Chesapeake Bay both through the Susquehanna and through the Potomac.

The large limestone deposits underlying Pennsylvania's soil have resulted in the formation of many caves through underground drainage and in the occurrence of a number of big springs which are the outlets of subterranean streams—the most interesting of which is Boiling Springs in Cumberland County, with a flow of 22½ million gallons a day. In the counties of Centre, Blair, Clinton, Franklin, Bucks, Lehigh, and Lancaster, are thirty great springs, no one of which has a flow of less than one million gallons of clear water every day.

Approximately one-eighth of all Pennsylvania land is publicly owned. By far, the largest areas are held by the Department of Forests and Waters as forest and park land,

and by the Pennsylvania Game Commission as game refuges and hunting areas. The total acreage under the custody of these two agencies is 2,800,737.

The Federal Government owns 517,918 acres within the Commonwealth including Allegheny National Forest in Elk, Forest, McKean and Warren Counties, and several historic sites, of which the largest is the Battlefield of Gettysburg. It also owns one soil conservation demonstration area in Bedford County, and various military installations and supply depots. Veterans' hospitals and federal prisons are not included in this total of federally-owned land.

Many of the State's holdings are such historic sites as Valley Forge, Daniel Boone's birthplace in Berks County, and Pennsbury Manor, the re-created country home of William Penn, in Bucks County along the Delaware. Most of the State park and forest areas are in regions of great scenic beauty, such as Cook Forest with its virgin pines and hemlocks, and Rickett's Glen with its romantic chasms and its chain of waterfalls. These areas are now being preserved in the ownership and for the pleasure of all our people.

Because of its many spots of great historic interest, as well as the variety of its scenic and outdoor attractions, Pennsylvania ranks high among the states in recreational travel and as a vacation land. According to conservative estimates, aided by a definite survey completed by the State Highway Department in 1951, the revenue accruing from this business to Pennsylvania was more than \$800,000,000 in that year. An exhaustive survey made by a great national research unit showed that Pennsylvania stood third among the states as "point of destination for traveling American families."

Pennsylvania Land Use

	<i>Square Miles</i>	<i>Percent</i>
Total Area	45,331.4	
Forest Land	23,639.9	52.1 of Total Area
Farm Woodland	5,349.3	22.6 of Forest Land
County and Municipal Forest Land	205.2	0.9 of Forest Land
Non-Forest Land	21,694.5	47.9 of Total Area
Farm Land—1949 and 1950	22,051.3	48.6 of Total Area
Arable Land	12,413.8	56.3 of Farm Land
Pasture Land*	2,830.0	12.8 of Farm Land
Woodland	5,349.3	24.3 of Farm Land
Other Land	1,458.1	6.6 of Farm Land

* In addition to this pasture land, 1,736 square miles of crop land and 1,458 square miles of woodland were pastured in 1949.

Recreation Land	<i>Number</i>	<i>Acres</i>
Game and Fishing Land		900,633
Playgrounds	454	577
State Forest Picnic Areas	56	2,209
State Forest Vistas	3	38
State Forest Monuments	13	2,425
Parks	603	144,072
Parks—City and County	552	36,177
Parks—State	33	103,987
Parks—National	6	3,427
Historic Parks and Shrines	12	481

Publicly Owned Forest and Recreation Land

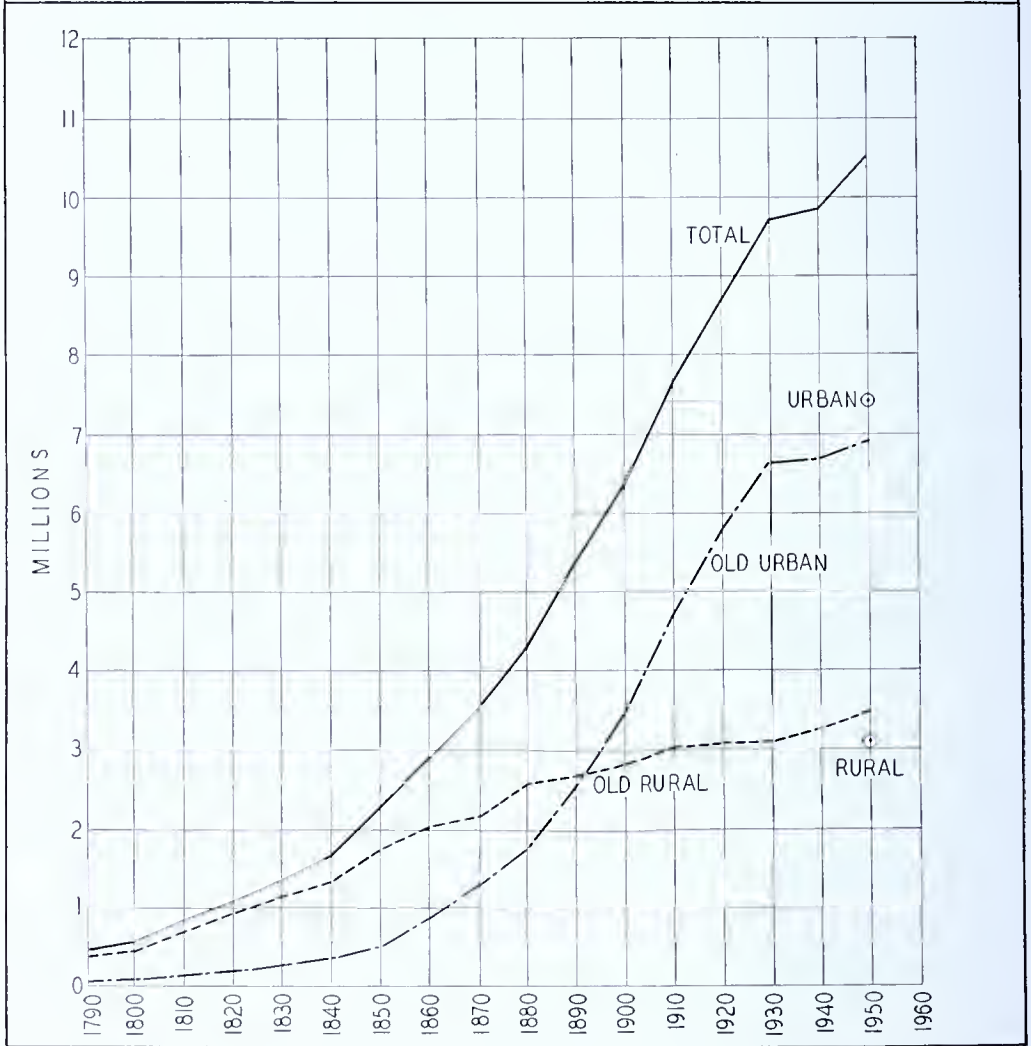
	<i>Acreage</i>	<i>Percent</i>
Total Forest and Recreation Land	3,512,466	12.1 of Total Area
Federal Total**	517,269	14.7 of Publicly Owned
National Forest Land	468,991	90.6 of Federally Owned
Military Installations and Depots	40,366	7.8 of Federally Owned
Soil Conservation	5,134	1.0 of Federally Owned
National Parks & Historic Sites	3,427	0.6

** Does not include hospitals and prisons.

State Total	2,863,901	81.6 of Publicly Owned
State Forest	1,798,883	62.8 of State Owned
State Parks	103,987	3.6 of State Owned
State Game & Fishing Land	900,633	31.5 of State Owned
State Institution & College Land	41,170	1.4 of State Owned
State Military Reservation	18,679	0.7 of State Owned
Capital Park	641	
Historic Parks and Shrines	481	Less than .01%
County and Municipal Forests	131,296	3.7 of Publicly Owned

(Some of the park acreage may also be included in Municipal forest area. It has not been included in total publicly owned land because of this duplication.)

URBAN AND RURAL POPULATION OF PENNSYLVANIA 1790-1950



PENNSYLVANIA DEPARTMENT OF COMMERCE, STATE PLANNING BOARD

This chart shows the history of Pennsylvania's population growth for a hundred and fifty years. Since 1890 the urban inhabitants have always exceeded those living in rural areas, but between 1930 and 1940 the rural grew faster than the urban population. This trend was reversed again after 1940.

(A new definition of urban population was adopted in 1950.)

Population and Vital Statistics

The 1950 report of the U. S. Census on Pennsylvania's population shows a definite reversal of the downward trend recorded for the State's growth rate since 1910. An increase of 597,832 in the State's population during the ten-year period between 1940 and 1950 represents a rise of more than 6% as compared with only 2.8% between 1930 and 1940.

While the report of the U. S. Census showed Pennsylvania to be third among the states in total population in 1950, that result was influenced by the large number of men in the armed forces stationed in California at the time of the Census count and thereafter. A later report showed that Pennsylvania was second in civilian population, leading California by 67,000 as of April 1, 1950.

It is probable, however, that the rate of growth stimulated by the great increase in the birth rate in the past six years will not continue at quite so high a level over the next decade. A reference to the table on Vital Statistics, Page 20, will show that the increase in births and also the natural increase—a balance of births against deaths—rose to a maximum in 1947 and declined in the three following years.

Until 1947 the largest recorded number of births in the State's history had occurred in 1921—a total of 229,452 children having been born in that year. The birth rate of 1921 was higher than that of any later year, including 1947, though the births in 1947 reached the record total of 248,513.

Following the Second World War two influences contributed to the high record of births in the State and Nation: the large number in the marriageable group because of the high birth rate following the First World War; and

the high percentage of marriages, which always has been noted during and immediately after a period of military activity.

The lowest number of births at any time during the past forty years occurred in the year 1933 when only 157,059 children were born.

It is probable that beginning in the late 1950's the State and National birth rates will show a decided drop because of the relatively small number of births in the 1930's.

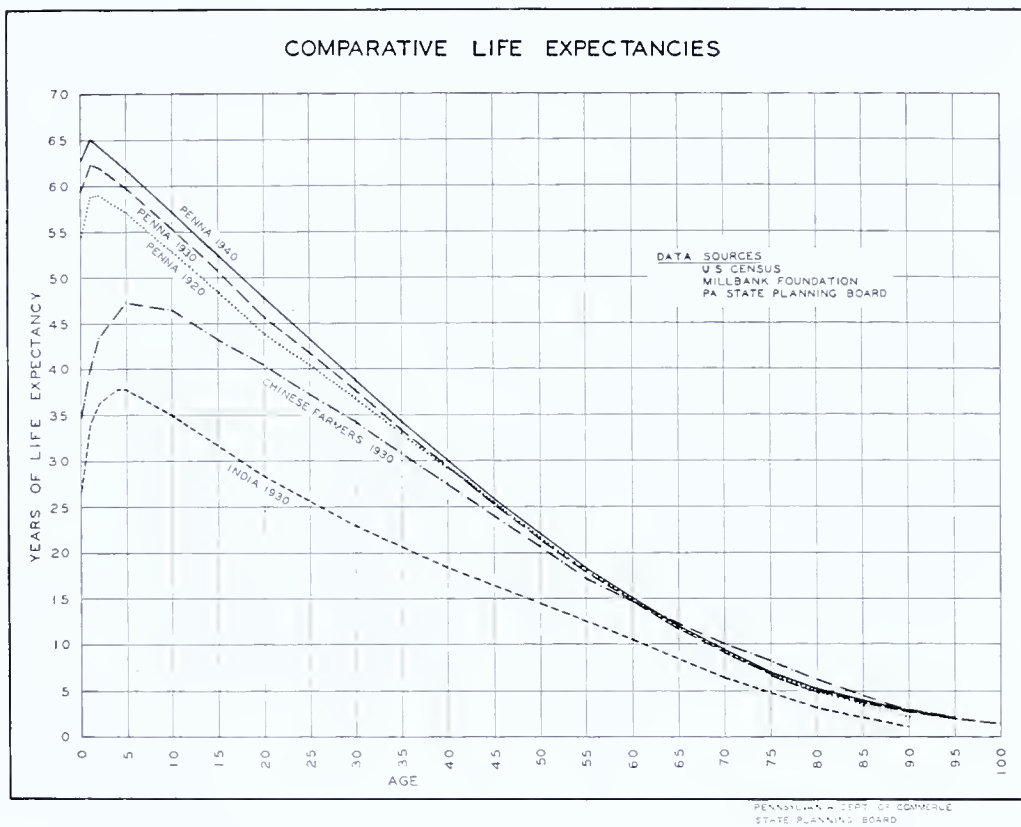
Although our population has increased by 866,662 since 1930, the number of deaths has declined slightly as a consequence of the lowered infant mortality and the increased life expectancy at all ages.

The proportion of older persons has grown steadily since the time of the first Census, and has shown a surprising increase in the past twenty years. There were 394,000 Pennsylvanians of sixty-five years or over in 1920, 4.5 percent of the total population. By 1930, the number had increased to 508,000 and the percentage to 5.27; by 1940, the number was 677,468 and the percentage 6.84; by 1950, the percentage of older people had risen to 8.6 and their number exceeds 900,000. Thus, while our total population has gained approximately 20% in 30 years, the population of older people has increased nearly 130%.

The proportion of older people to the total will eventually reach a limit, but it is likely that in the foreseeable future there will always be a higher percentage of people of sixty-five years or over in Pennsylvania's population than was ever true in the past.

Questions are frequently asked as to the future growth of the State's population. An examination of what occurred between 1940 and 1950 in the total population and in the rise and fall of births shown in the Vital Statistics Table will make it clear how unreliable such estimates are likely to prove.

For the United States as a whole it is possible to estimate future population on the basis of present trends and to have some expectation that the estimate will prove true.



For a state or a civil subdivision such estimates are far less reliable since internal migration results from economic and social forces which are not predictable. All that it is possible to say is this: if present long-term trends in births, deaths and life expectancy continue, and no important economic forces produce unusual movement into or out of the State, Pennsylvania's total population (both military and civilian) should exceed 11,000,000 by 1960 and reach a maximum in the Census of 1970 and afterwards either stabilize or slightly decline from its peak figure. This is to be regarded, however, not as a prediction, but as a summary of present trends of births, deaths, and migration.

On the basis of the 1950 Census, Pennsylvania has a population density of 231.6 per square mile. This is far higher than the density of many European and Asiatic nations. France, on the basis of its 1946 population, had a

density of 190 per square mile; Greece, 149; and China, 115. The State is not far below the population density of India and Pakistan, which was 246 per square mile in 1941.

The distribution of population is more important to the well-being of the people of an area than absolute numbers. In this respect our State is peculiarly fortunate.

In Pittsburgh and Philadelphia, Pennsylvania has two of the largest cities in the Nation.

This does not imply an undue concentration in great urban centers since Pennsylvania has more small cities and towns than any other state. It has six cities of 100,000 or more, nine with a population of between 50,000 and 100,000, eleven urban communities between 25,000 and 50,000, seventy between 10,000 and 25,000, 128 between 5,000 and 10,000, 138 between 2,500 and 5,000 and in addition contains 628 towns and villages of less than 2,500 population. The State has also a larger number of people residing in small towns than is true anywhere else in our Nation.

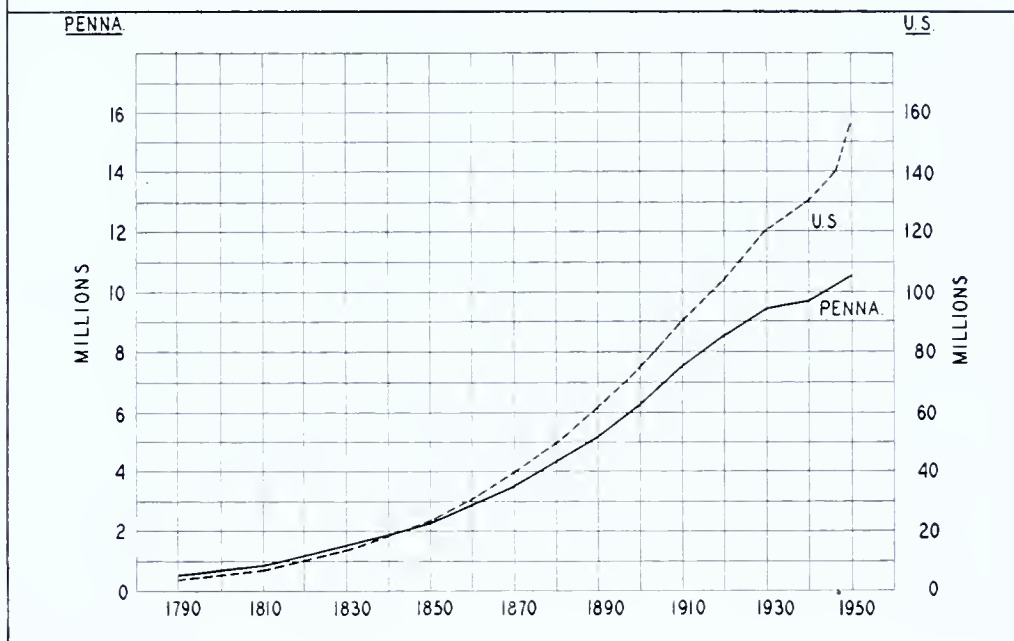
We commonly think of New England as a section of our country notable for its smaller communities, but in the number of places under 10,000 Pennsylvania has five and one-half times as many—the exact numbers being 894 such communities in Pennsylvania and 162 in all New England.

It might be concluded from these figures that Pennsylvania's population dwells entirely in cities and towns, but this is far from true. At the time of the taking of the 1950 Census, 3,331,068 Pennsylvanians were living in rural territory. They constituted 31.7% of the total population and represented the largest rural population of any state in the Nation.

Pennsylvania's people include representatives of almost all the races of the World.

English and Welsh Quakers in the company of William Penn, as well as Irish, and Germans of the Rhineland and

POPULATION TRENDS FOR THE UNITED STATES AND PENNSYLVANIA



PENNSYLVANIA DEPARTMENT OF COMMERCE, STATE PLANNING BOARD

the Palatinate, made their way to Pennsylvania before the close of the Seventeenth Century.

In our southeastern counties the English and Welsh predominated. Pennsylvania's German settlers spread out into the rich farm lands south of the Blue Mountains. The Scotch and Scotch-Irish who came a generation later moved into the regions west of the Susquehanna and beyond the Allegheny Mountains. In our coal counties first the Welsh and afterwards hundreds of thousands of the peoples of southern and eastern Europe found homes and opportunity.

In Pennsylvania was bred a large part of the rugged pioneer stock which settled the territory west of the Alleghenies in the closing decades of the Eighteenth Century. Pennsylvania also contributed a large share of the thousands who moved west toward the gold fields of California in 1849. Throughout its history the State has always exported people to the less densely settled parts of our Country.

Pennsylvania

Population—Changes and Density

<i>Year</i>	<i>Population</i>	<i>Change</i>	<i>Percent of Change</i>	<i>Density per Sq. Mi.</i>
1800	602,365	.....	.....	13.3
1810	810,090	207,726	34.5	17.9
1820	1,049,458	239,367	29.5	23.2
1830	1,348,233	298,775	28.5	29.7
1840	1,724,033	375,800	27.9	38.0
1850	2,311,786	587,753	34.1	51.0
1860	2,906,215	594,429	25.7	64.1
1870	3,521,951	615,736	21.2	77.7
1880	4,282,891	760,940	21.6	94.5
1890	5,258,113	975,222	22.8	116.0
1900	6,302,116	1,044,003	19.9	139.0
1910	7,665,111	1,362,995	21.6	169.1
1920	8,720,017	1,054,906	13.8	192.4
1930	9,631,350	911,333	10.5	212.5
1940	9,900,180	268,830	2.8	218.4
1950	10,498,012	597,832	6.0	231.6

Pennsylvania

Vital Statistics*

<i>Year</i>	<i>Births</i>	<i>Birth Rate Per 1,000 Population</i>	<i>Deaths</i>	<i>Death Rate Per 1,000 Population</i>	<i>Natural Increase</i>
1929	189,521	19.7	117,365	11.6	72,156
1930	189,573		111,606		77,967
1931	178,678		111,936		66,742
1932	168,553	16.7	109,204	11.3	59,349
1933	157,059		106,109		50,948
1934	160,232		109,601		50,631
1935	161,189		108,555		52,634
1936	159,462		112,711		46,751
1937	161,333		114,946		46,387
1938	166,002		107,282		58,720
1939	161,254		108,007		53,247
1940	165,456		111,977		53,479
1941	174,591		106,096		68,495
1942	198,315	20.7	109,176	10.5	89,139
1943	199,366		115,452		83,914
1944	178,370		110,333		68,037
1945	173,799		109,193		64,606
1946	218,376		107,683		110,693
1947	248,513		110,459		138,054
1948	227,227		109,202		118,025
1949	224,581		108,363		116,218
1950	217,227		110,632		106,595

* Bureau of Vital Statistics, Department of Health.



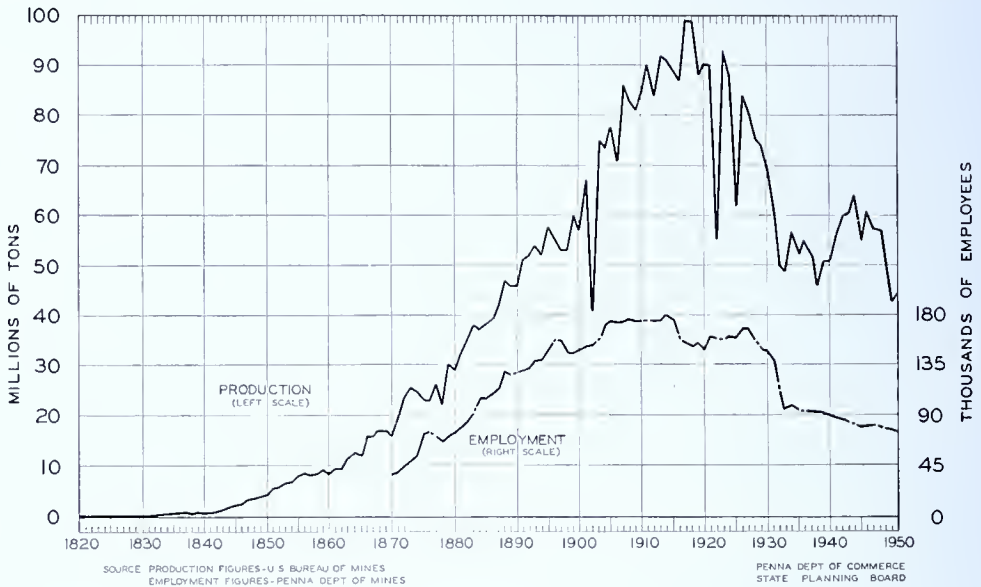
Mineral Products

In the thirty-eight years from 1911 to 1949 the value of Pennsylvania's mineral products reached a total of \$33,536,495,000.

According to the latest Minerals Yearbook of the United States Bureau of Mines, nearly 18 percent of all United States mineral products during the past thirty-eight years have come from the mines, quarries and oil wells of the Keystone State. No other State can come even close to this record.

A list of Pennsylvania's important mineral products includes cement, anthracite, coke, pig iron, ferroalloys, natural and manufactured pigments, slate, stone, sulphuric acid from zinc smelters, and cobalt, in all of which the State is America's leading producer. It also includes bituminous coal, lime and clay, in which Pennsylvania is sec-

ANTHRACITE PRODUCTION AND EMPLOYMENT



ond, and a great variety of other minerals, such as natural gas, natural gasoline, petroleum, pyrites, glass sand, gravel, gold, silver, copper, graphite and tripoli.

The value of all minerals produced in our State in 1949 exceeded one billion dollars and the value of all minerals and primary mineral products such as pig iron, cement and steel, was \$1,944,467,000.

The State's Bradford oil field is the oldest in the World. It was in that field that the first commercial oil well, Drakes' Well, was drilled in 1859.

For many years Pennsylvania was America's only producer of commercial quantities of coal; it is now second in the output of bituminous coal and mines nearly one-half of the World's anthracite.

The highest point of anthracite tonnage was attained in 1917 when 99,612,000 tons were mined. The 1951 tonnage was 41,509,000.

The year 1918 was the high point for bituminous coal production in the State, with a tonnage of 178,551,000. In 1951 the Commonwealth produced 108,620,000 tons.

Pennsylvania's coke production is far greater than that of any other State. It amounts to approximately 30 percent of the National total. In 1951, 24 percent of all by-product coke and 87 percent of all beehive coke were produced in the Keystone State. It is on this dominance in the coke industry that Pennsylvania's national leadership in the output of iron and steel has been based.

The State's by-product ovens also yielded 222,081,780 thousand cubic feet of gas, 254,998,940 gallons of coke oven tar, 520,971,742 pounds of ammonia, 76,529,392 gallons of crude light oil, and many million gallons of benzol and toluol, as well as other important products basic to the organic chemical industries. Under the old beehive processes of coke production these chemical raw materials and gases were lost.

Coke oven gas is used as a source of heat and power and of valuable hydrocarbons. Coke oven ammonia yields nitrogenous fertilizer. The coal tars and light oils are the raw materials from which a variety of new drugs, dyes, plastics, and industrial chemicals are now derived.

Pennsylvania's petroleum production reached its peak in 1891 with an output of more than 31,000,000 barrels. It fell to a low of 7,400,000 barrels in 1921, but water-pumping has resulted in an increased flow, which in 1950 totaled 12,007,520 barrels. The State's petroleum resources, while not great in comparison with those of several Western States, are important because of the unique physical and chemical qualities of this oil which make it a preferred source for refined lubricants necessary in the operation of high-speed machinery.

Natural gas has been of particular importance in the Western portion of the State as a fuel for the glass furnaces and as a source of carbon. The largest gas output on record was 138,000,000,000 cubic feet in 1906. Production fell to 61,000,000,000 cubic feet in 1932. The Leidy field in Clinton County was tapped late in 1949 and the State's

production of natural gas increased from 70,000,000,000 cubic feet in 1949 to 124,843,000,000 cubic feet in 1950.

Production of iron ore in 1950 totalled 1,974,000 tons, principally from the Cornwall Mine, which also produces the State's relatively small yield of silver and gold, and is the chief American source for the metal cobalt.

Pennsylvania
Mineral Production
Production of Basic Products

Year	Coal			Coke		Total
	Anthracite	Bituminous	Total	By-Product	Beehive	
	(Amounts in Thousands of Tons)					
1920	89,598	170,608	260,206	7,730	15,908	23,639
1921	90,473	116,014	206,486	5,303	4,466	9,769
1922	54,683	113,148	167,831	7,152	6,840	13,992
1923	93,339	171,880	265,219	9,186	16,438	25,624
1924	87,926	130,634	218,560	8,426	8,501	16,927
1925	61,817	136,928	198,745	9,853	9,574	19,427
1926	84,437	153,042	237,479	11,201	10,722	21,923
1927	80,096	132,965	213,061	11,061	5,716	16,777
1928	75,348	131,202	206,550	13,475	3,442	16,917
1929	73,828	143,516	217,344	14,489	5,368	19,857
1930	69,385	124,463	193,848	12,529	2,011	* 14,540
1931	59,646	97,659	157,305	7,525	855	8,380
1932	49,855	74,776	124,631	4,038	506	4,544
1933	49,541	79,296	128,837	6,170	670	6,840
1934	57,168	89,826	146,994	6,834	721	7,555
1935	52,159	91,405	143,564	8,078	564	8,642
1936	54,580	109,887	164,467	12,571	1,213	13,784
1937	51,856	111,002	162,858	13,701	2,559	16,260
1938	46,099	77,705	123,804	7,119	482	7,601
1939	51,487	92,584	144,071	10,994	1,126	12,120
1940	51,485	116,603	168,088	14,862	2,550	17,412
1941	56,368	130,240	186,608	15,632	5,891	21,523
1942	60,328	144,073	204,401	16,310	7,309	23,619
1943	60,643	141,050	201,693	16,519	6,934	23,453
1944	63,701	146,052	209,753	16,977	6,171	23,148
1945	54,934	132,965	180,089	15,255	4,584	19,839
1946	60,507	125,155	202,880	12,795	4,027	16,822
1947	57,190	145,880	203,070	16,475	5,913	22,388
1948	57,140	132,550	189,690	16,650	5,734	22,384
1949	42,664*	91,483*	134,147	17,769	2,899	17,688
1950	44,392*	102,500*	146,892	16,333	5,193	21,526
1951	41,509*	108,620*	150,129	17,280	6,396	23,646

* Preliminary figures.

Sources:
United States Bureau of Mines.
Pennsylvania Department of Mines.

Pennsylvania
Mineral Production
 Production of Basic Products

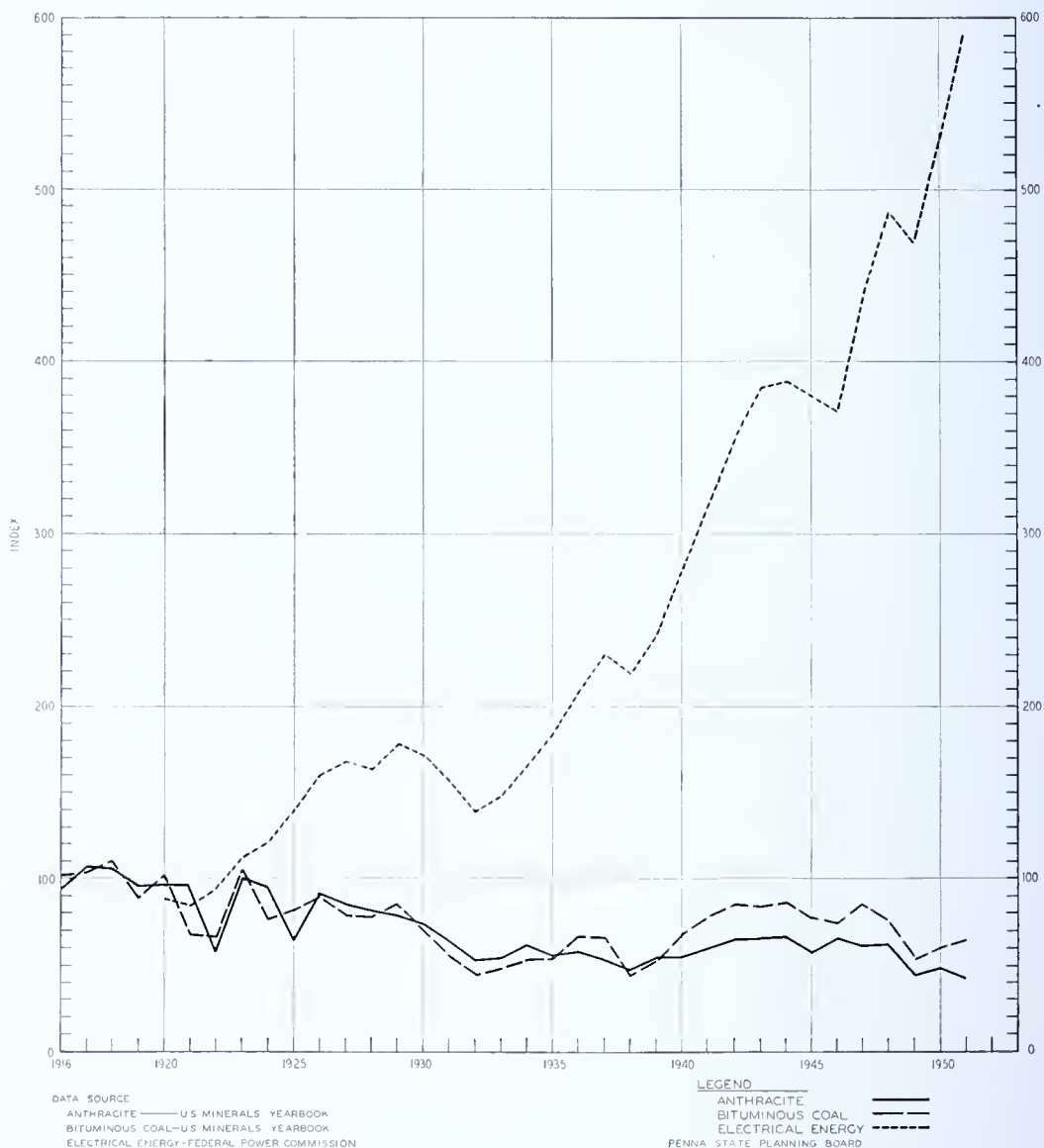
<i>Year</i>	<i>Iron Ore Tons</i>	<i>Lime Tons</i>	<i>Stone Tons</i>	<i>Petro- leum Bbls.</i>	<i>Cement Bbls.</i>	<i>Electric Energy by Public Utilities (Thousands of K.W.H.)</i>
<i>(Amounts in Thousands)</i>						
1920	1,193	784	14,297	7,438	28,294	4,021,000
1921	288	510	9,023	7,418	26,403	3,801,000
1922	863	720	12,732	7,425	33,248	4,265,000
1923	1,108	773	15,679	7,609	38,386	5,110,000
1924	1,391	700	14,560	7,486	41,629	5,433,000
1925	1,679	795	16,125	8,097	42,466	6,249,000
1926	1,223	794	16,629	8,961	42,836	7,202,000
1927	1,299	814	16,015	9,526	44,197	7,626,000
1928	1,164	834	16,547	9,956	41,736	7,410,000
1929	1,248	783	18,169	11,820	39,980	8,075,000
1930	1,099	634	15,138	12,803	38,254	7,840,000
1931	426	497	11,124	11,892	28,820	7,233,000
1932	89	374	10,842	12,412	16,045	6,367,000
1933	305	430	12,802	12,624	12,438	6,767,000
1934	601	435	15,251	14,478	15,439	7,453,000
1935	1,116	532	8,570	15,810	15,326	8,225,000
1936	1,307	661	15,814	17,070	21,827	9,455,000
1937	1,945	693	16,091	19,189	22,654	10,446,000
1938	2,040	532	12,134	17,426	20,233	9,951,000
1939	2,237	691	15,744	17,382	24,931	11,024,000
1940	2,269	833	19,278	17,353	26,639	12,517,000
1941	2,532	1,003	23,507	16,750	33,338	14,245,000
1942	2,248	1,030	23,132	17,779	35,056	16,027,000
1943	2,275	1,021	20,000	15,757	20,116	17,466,000
1944	1,960	1,026	18,175	14,118	12,166	17,623,000
1945	1,727	904	17,708	12,515	15,283	17,350,000
1946	1,520	972	18,884	12,996	30,377	16,881,000
1947	1,674	1,046	22,353	12,696	36,258	19,825,000
1948	1,833	1,086	23,172	12,667	41,312	22,018,000
1949	1,604	911	21,226	11,374	53,651	21,202,000
1950	1,974			12,008	41,745	23,996,000

Sources:

Iron Ore and Cement—Pennsylvania Department of Internal Affairs.
 Petroleum, Lime, Stone—United States Bureau of Mines.
 Electric Energy—Federal Power Commission.

INDICES OF THE PRODUCTION OF COAL AND ELECTRIC POWER IN PENNSYLVANIA

(BASE 1916 TO 1920 YEARLY AVERAGE)



Energy Production

In the total production of the fuel energy on which we depend for the heating of our homes, the operation of almost all our transportation, and the turning of the wheels of industry, Pennsylvania exceeds every state in our Nation. In addition to its coal production, which has been greater than that of any other state, there is also a sizable output of energy from our natural gas and petroleum wells, and from our many sources of water power.

Energy output is most conveniently measured by the amount of heat needed to raise a pound of water one degree in temperature. This is called a British Thermal Unit. One pound of anthracite, for instance, if completely converted into heat could raise 13,600 pounds of water one degree.

A recent study of the State's energy output made by the State Planning Board shows that Pennsylvania's output of energy in 1943, the last year for which complete figures are available, was equal to 5,514 trillion British Thermal Units. This is a figure almost too large for the human mind to conceive. It means that the heat energy produced by our State in one year, if completely used, would raise 15 billion tons of water from the freezing to the boiling point.

Perhaps it would be easier to comprehend the vital contribution which our State makes to the activities of our Nation if, as one journeys across the continent from the Atlantic to the Pacific, he would take time to realize that nearly one-sixth of all the energy that moves our trains, lights our cities, and provides the enormous power requirements of the busiest Nation in the World, comes from the mines, the wells, and the waterfalls of the Keystone State.

Among the states Pennsylvania is the second largest producer of electric energy by public utilities. It is the largest producer of non-utility electric energy, and the largest producer of electric energy from the burning of fuel.

As a leading coal State, the Commonwealth also provides an important part of the fuel used to produce the electric energy generated by many of its neighbors.

These facts are indicative of the tremendous reserves of power available for the manufacturers of the Commonwealth. They have made good use of these resources.

In 1946 the factories and mines of the Commonwealth used nearly one-ninth of all the electricity employed by the industries of our Nation. The total of 14,404,292,000 kilowatt-hours far exceeded that of any other state. It was greater by three billion kilowatt-hours than the total energy consumption of all the states on the Pacific Coast.

The iron and steel plants of our State are the leading users of electric energy, with a total in 1946 of nearly five billion kilowatt-hours. Next comes coal mining, with two and a half billion; next, our quarries and glass works, with 1,228,000,000; and then our oil wells and coke ovens, our paper mills, our chemical plants, our food packers, and our textile mills.

Pennsylvania's total electric production—3,052,000,000 K.W.H. for the month of January, 1952, represents an increase of more than 5 percent over its output in the same month of the preceding year and was the highest monthly total ever attained.

Ninety percent of Pennsylvania's electric energy is generated by steam-driven machinery which uses coal; nine percent is generated in hydroelectric plants, and one percent by the use of internal combustion engines. Production of electricity in Pennsylvania consumed 15.9 percent of the bituminous coal produced in the State in 1950 and 8.7 percent of the anthracite.



On the Pennsylvania Turnpike

Transportation and Communication

Pennsylvania has always been a pioneer in the field of transportation.

The first hard-surfaced highway in the United States was constructed between Philadelphia and Lancaster between 1792 and 1796. This stone-surfaced roadway made possible for the first time the maintenance of a satisfactory stage service between Philadelphia and what was then Pennsylvania's leading interior city. It also led to the building of numerous taverns and relay stations along the whole length of the highway. It established an epoch-making travel time of only 12 hours between the two cities. For this journey the stage fare was \$3.50.

This speed of travel had nearly been equalled on the rougher road between Philadelphia and New York by a vehicle known as the "Flying Machine" which was able to cover the 90 miles between the Nation's two greatest cities within one day, with three changes of horses. Though this vehicle was extremely light, the pace was so

rapid that sometimes the horses died in harness during the trip.

Toward the beginning of the 19th Century and indeed from the earliest history of American travel the break-neck pace at which diligences were driven along those rough Pennsylvania roads excited the mingled admiration and terror of visitors from foreign lands. Speeds as high as seven miles an hour were sometimes attained on the downhill sections of these highways. But collisions and encounters with large boulders and stumps caused numerous accidents, and many a sprained wrist and broken kneecap resulted when passengers were hurled from light two-wheelers proceeding at this dizzy pace.

As our highway systems gradually pushed west and road improvement became of greater and greater public importance, it finally became possible to make the entire journey from Philadelphia to Pittsburgh in less than six days—the stage fare for the trip being \$20.00.

From this beginning it may seem a far cry to the State's modern highway system of more than one hundred thousand miles, which includes the Pennsylvania Turnpike, the finest, all-weather, four-lane protected road on our Continent. This Superhighway, which tunnels its way through the Allegheny Mountains, now spans the State from the Ohio Border to Philadelphia, a distance of 327 miles. An extension of approximately 30 miles to the New Jersey State line, where it will join the New Jersey Turnpike, is planned for early construction.

In the field of railroad transportation the Commonwealth is equally progressive.

As early as 1809 a horse-drawn railway car with iron wheels ran over a very short track at Leiperville, not far from Philadelphia.

When the Mauch Chunk Railway was completed in 1827 for the transportation of coal from the mines by gravity and mule power, its nine miles of track formed the longest and most important railway in our Nation.

In 1829 the first steam locomotive ever used in America



Urban redevelopment in Pittsburgh's Golden Triangle

made two trips between Carbondale and Honesdale on rails laid by the Delaware and Hudson Canal Company.

The Philadelphia-Columbia line, spanning a distance of 81 miles, was completed in 1834 through an appropriation of \$2,000,000 by the Pennsylvania Legislature. This railroad was chartered in March, 1823, as a steam road for the transportation of passengers and freight. The charter was granted two years before the opening of the first passenger-carrying railway in the World—a 38-mile horse-drawn project in Great Britain—and seven years before the opening of the Liverpool and Manchester Railroad in that country, which was the first regular steam-driven line.

When coal began to be used as a fuel for operating steam locomotives, it was Pennsylvania's anthracite which supplied the motive power. The conveniences afforded by this concentrated fuel provided a great stimulus for the extension of American railroad systems throughout all the inhabited parts of our Country. During the later years of railroad development Pennsylvania's bituminous coal succeeded the State's anthracite as the chief source of motive power.



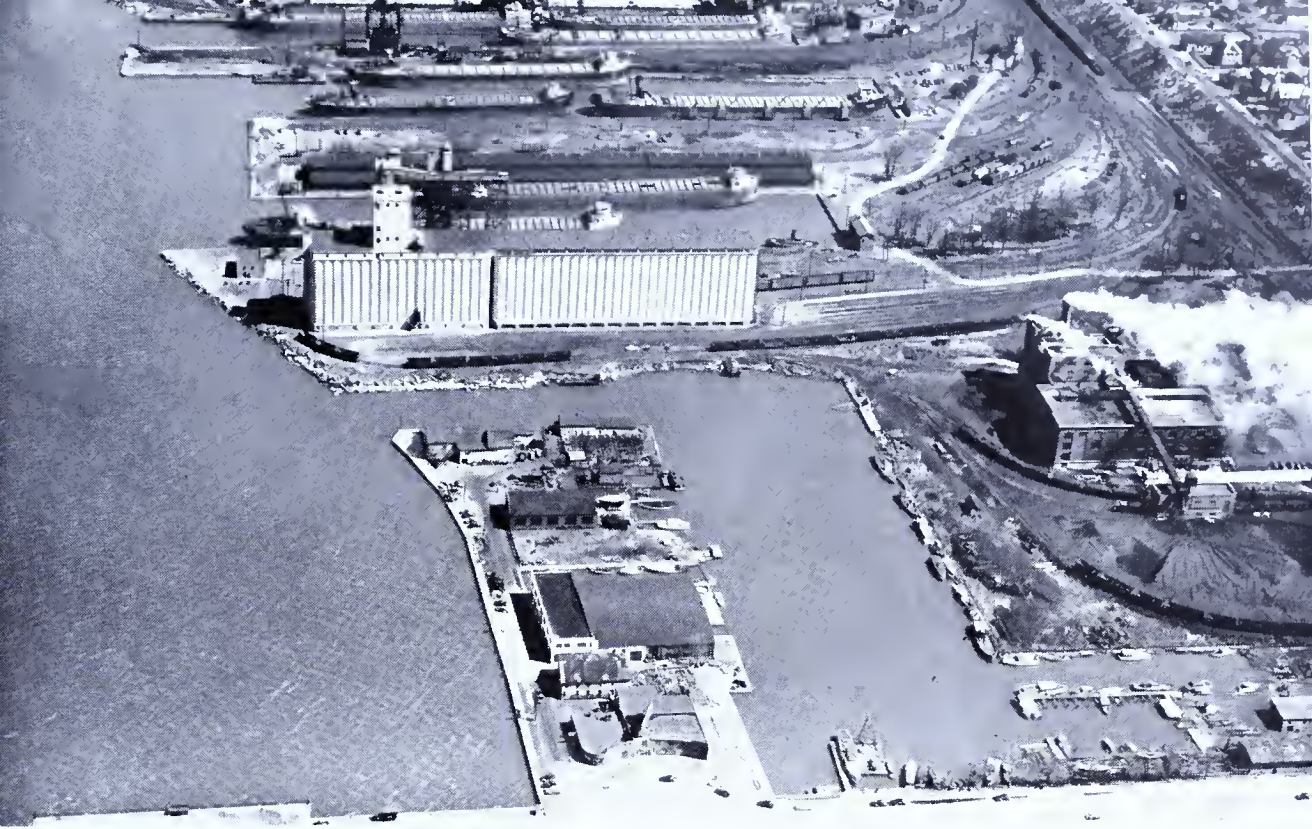
Philadelphia's Waterfront

Since those early days Pennsylvania has remained in the forefront of railroad development and, despite its relatively small area, has the third longest track mileage in the Nation—a total of 11,290 miles, as reported to the Department of Internal Affairs by the State's 71 railroad companies.

In Pennsylvania, every county but one, is served by these roads which, together with our system of State highways and the Turnpike, provide the people of the Commonwealth with the best transportation facilities available anywhere in the Nation.

Pennsylvania is not only a leader in railway development. It is also the foremost user of America's railway facilities. In the year 1950 the State accounted for 345,500,000 tons of revenue railroad freight, more than one-seventh of all the carload freight transported by the Class I steam railways of the United States.

Pennsylvania's shipments of coal and steel provided the raw material and power for the industries of half a dozen states and yet the freight record of the Commonwealth in



The Harbor of Erie

manufactured and miscellaneous goods also stands highest in our Nation.

Just how important Pennsylvania's freight tonnage is to the American economy is shown by the fact that in 1950 the State shipped and received more carload freight than the combined tonnage of the three Pacific States and the eight Mountain States.

One of the greatest advantages of Pennsylvania's geographic location is the fact that it is the only State with outlets from its own ports to the Atlantic, the Gulf of Mexico, and the St. Lawrence. The Port of Erie connects the State by water with Canada and the Great Lakes system. The Port of Pittsburgh provides access to the Mississippi River and the Caribbean Sea. The Ports of Philadelphia and Chester are our State's outlets to the Atlantic.

In total volume of water-borne commerce Philadelphia is the second most important port on the Atlantic Coast.

By virtue of its position at the head of the Ohio, and at the juncture of the Monongahela and Allegheny Rivers,

Pittsburgh is the busiest interior river port in the United States.

Erie is an important center for the Great Lakes fisheries, and maintains a flourishing trade in grain and coal with other Lake ports, both in the United States and Canada.

As of January 1, 1951, Pennsylvania had 368 civil airports, serving all of its principal cities and many of its rural communities. The State has a very high rating for air safety.

According to the latest report of the Federal Communications Commission, there were 3,316,793 telephones in use in Pennsylvania on the first of January, 1952. On January 1, 1946, only six years before, the total had been 1,835,782.

As of January 1, 1947, there were 1,378,000 telephones in use on the whole continent of South America—more than a million fewer than in the Commonwealth of Pennsylvania. The South American continent embraces an area of 6,937,551 square miles, and contains approximately 84,000,000 inhabitants, while Pennsylvania contains 45,333 square miles, and has a population of 10,498,012. The Union of the Soviet Socialist Republics, with 8,473,000 square miles of territory and a population of approximately 211,000,000 had some 1,500,000 telephones in 1947, which is nearly one million fewer than our Commonwealth had in that year.

Pennsylvania was a pioneer in both the radio and motion picture industries. The first commercial broadcasting station in the World was located in Pittsburgh. The first projected moving picture was exhibited in Philadelphia in 1870.

America's first moving picture studio was opened in Philadelphia in 1898, and its first moving picture theatre was established in Pittsburgh in 1905.

There are today approximately 1200 picture theatres in Pennsylvania, and 168 radio or television stations, a number which is constantly growing.

Pennsylvania

Transportation and Communications

Transportation

<i>Highways</i>	
Improved and Unimproved Highways—1952	104,049 miles
Improved	67,871 miles
Unimproved	36,178 miles
Total State Funds disbursed for Highways—1951	\$178,984,000 *
<i>Automobile Registrations—1951</i>	
Passenger Cars	2,700,386
Commercial Cars	502,255
Motor Buses	12,700
Motorcycles	26,481
Operator Licenses	3,992,083
Scheduled Motor Carriers	482

* Including \$14,782,000 bonds issued by the Bridge Authority.

Railroads

Companies Operating in Pennsylvania—1950 (Listed)	71
Systems Operating in Pennsylvania—1950	15
Total Railroad Mileage in Pennsylvania—1950	11,290
<i>Revenue Freight Carloadings—1950:</i>	
Tons Originated	192,685,000
Tons Terminated	152,829,000

Ports

Philadelphia, including Chester	Delaware River
Erie	Lake Erie
Pittsburgh	Ohio River
Civil Airports—January 1, 1952	368
Scheduled Air Lines serving major Airports	10
Scheduled Air Lines serving major Airports (Freight only)	2

Communications

Telephones

Telephones in Service in Pennsylvania—Jan. 1, 1952	3,316,793
Telephone Pole Mileage in Pennsylvania—Jan. 1, 1952	37,138 miles
Telephone Wire Mileage in Pennsylvania—Jan. 1, 1952*	10,863,145 miles

* Includes cable installations.

Telegraph

Telegraph Pole Mileage in Pennsylvania—Jan. 1, 1952	2,129 miles
Telegraph Wire Mileage in Pennsylvania—Jan. 1, 1952	31,299 miles

Radio

Licensed AM Stations—1952	114
Licensed FM Stations	47
Licensed Television Stations	7
(The first Government licensed radio station in the United States was Station KDKA of Pittsburgh, November 7, 1921.)	

Publications—1952

Periodicals	425
Newspapers	565



Pennsylvania has 15,000,000 acres of forest land



Industrial Production and Employment

In 1950, Pennsylvania's industrial production was valued at \$19,484,852,500, more than twice the amount recorded for the year 1941, according to the records of the Department of Internal Affairs.

Wages and salaries totaled \$5,142,968,500. Except for the year 1948, this was also an all-time peak for the State, although the number of employes in industry—1,722,948—was lower than it had been at the height of the war in 1943.

The diversity and balance of Pennsylvania's industrial output are among the State's most remarkable characteristics. Though metals and the various metal industries are of overwhelming importance in most sections, as is shown

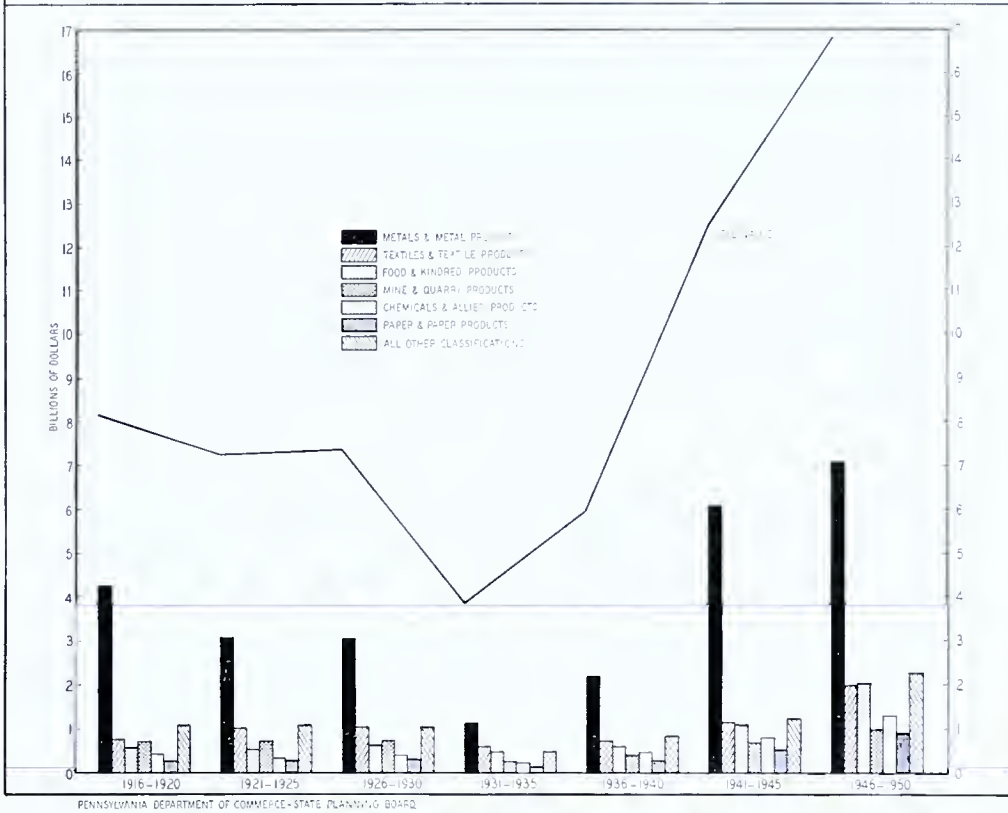
on Pages 44 and 45, the production of textiles and foods exhibits a steady growth. Each of these lines of manufacture passed a value of two billion dollars in 1950. (Metals, \$8,737,342,400; textiles, \$2,282,637,500; food, \$2,175,915,900; chemical industries, which include the important oil refineries along the Delaware, yielded \$1,617,475,400; paper and printing industries, which have grown steadily in value and employment over a period of 30 years, exceeded \$1,033,760,000 in 1950; mine and quarry products were valued at \$1,025,970,800; glass, clay and stone products and leather and rubber goods each yielded more than 500 million dollars; lumber and wood products totaled \$323,311,900; tobacco products more than \$140,780,000, and the large class of miscellaneous products which includes ship building and coke refining, more than \$787,618,000.)

Chief among the metal products and of primary importance in the industrial pattern of the State is the production of iron and steel.

The value of the products of Pennsylvania's iron and steel industries is more than one-third that of the entire manufacturing of the State. For more than a century the Commonwealth has led the Nation in its steel and iron output, and for more than a half century its production has been greater than that of any nation in the World, except our own.

How important Pennsylvania steel has been to the United States in years of peace and war is illustrated by a simple comparison. In 1943, when the fortunes of war largely turned on the ability of the United States to produce at high speed the ships and guns needed to equip the armies of the United Nations, Pennsylvania produced nearly 27,700,000 tons of steel. This was more than the output of Germany, and nearly equalled the combined output of Germany and Japan. It was twice that of Russia, and nearly twice that of Great Britain. It was obviously a decisive factor in the victory of the United Nations in the Second World War.

PENNSYLVANIA
TOTAL MANUFACTURE AND MINING
(FIVE YEAR AVERAGE VALUE OF PRODUCT)



Pennsylvania's steel-producing capacity, which increased more than that of any other State during the war and the post-war years, is far greater than the demands of all the State's industries, despite the fact that our Commonwealth is America's greatest user of steel. In 1950 the surplus semi-manufactured iron and steel shipped to other states was more than 9 million tons. This compares with the surplus of approximately 4,500,000 tons from Ohio, the next largest steel producer. In this respect, Pennsylvania's industries are in a far more advantageous position than those of any other of the great manufacturing states. Michigan, with its extensive automobile industries, consumes nearly 4 million tons of steel more than it produces. New York has a steel shortage of nearly 600,000 tons. New Jersey and New England are also important steel deficit areas and so, too, are Texas and California.

Because of its position in the center of a great bituminous coal field, and at the junction of two important rivers, Pittsburgh early established a leadership in the steel industry which has been challenged by no other section of our Nation. The 23,000,000 tons of steel-producing capacity, accredited to the Pittsburgh district in 1950 was 74 percent of the capacity of the entire State—the other large producing centers being Bethlehem, Erie, Johnstown, Coatesville, and the Harrisburg-Steelton area.

Large increases in capacity have occurred during the past two years in the Pittsburgh area and near Philadelphia where the largest steel mill ever to be constructed at one time is rapidly nearing completion.

Fifty years ago steel production was a relatively simple process since the product was originally only a controlled combination of carbon and iron. Modern steel is a far more complex material. Hardness, toughness, and resistance to high temperature and to continued stresses have been built into the various products of steel mills through the addition of nickel, vanadium, columbium, and other metallic elements. A modern automobile employs dozens of different types of alloy steel to provide the elasticity and the resistance to wear or temperature needed in its body or in its moving parts.

The greatest of all modern improvements in steel manufacture, and one believed for a long time to be impossible, was the discovery of alloys which produced a steel highly resistant to stain or rust, or to the attack of corrosive chemicals. Stainless steel today has become an accepted and indispensable material of thousands of uses in industry and in the home.

In all these improvements and developments Pennsylvania has had a foremost part and, while other industries have assumed a greater and greater importance throughout the course of the years, our leadership in the output of the ferrous metals has never been challenged. The steel capacity of Pennsylvania in 1951 was 29.5 percent of that of the entire Nation. The actual steel produced in 1951 was

in excess of 30 million tons, with the great new plant at Morrisville on the Delaware not yet in operation.

The heavy metals industries are, however, only one of the several important industries in which the State has established a first place. It also leads in the number of its textile mills and in the production of a great variety of textiles.

Among Pennsylvania's "firsts" are knitted underwear, lace goods, rayon, men's and boys' shirts and underwear, carpet yarns, linoleum, and the weaving of silk and rayon fabrics. Textiles are second to steel in employment among the State's productive industries.

These great textile industries are the result of a steady growth, beginning with the early Swedish settlers along the Delaware. These first colonists raised sheep, spun and wove wool, grew flax and produced fine linens.

Penn's enlightened policy of encouragement to textile industries led to the setting up of a linen factory in Germantown which was the second textile plant in America.

A part of Pennsylvania's success in the early production of yarn and thread was due to the invention of John Antes, a Moravian Missionary, born in Montgomery County in 1740. He devised a yarn distributor for the spinning wheel which greatly increased the speed of production of fine thread, and in Bethlehem at the Moravian settlement the spinning and weaving of cotton hemp and wool became an established industry in early Colonial days.

It was under the leadership of Benjamin Franklin in 1769 that the silk industry was first established in Pennsylvania. Mulberry trees were planted at various points in the city of Philadelphia, and by 1771 more than a ton of cocoons had been unreeled at the silk thread plant in that city. So quickly was this industry developed that silk raised in 1770 by Susanna Wright, Quakeress of Lancaster County, was made into a court dress for the Queen of England.

Before the time of the Revolution Samuel Wetherill, a Quaker merchant of Philadelphia, had established a factory to make woolens, cottons and linens with the aid of what was probably the first spinning jenny ever to be introduced into America. It was from Wetherill's factory that the cloth was provided to make uniforms for the soldiers of the Continental Army.

The printing and publishing industry of Pennsylvania has a long and honored history that extends back to the famous 18th Century Philadelphia printing shops of Christopher Sauer, William Bradford, and Benjamin Franklin.

The first successful type foundry in America was established in Philadelphia. The first books and newspapers west of the Alleghenies were published in Pittsburgh.

In recent years the industry has maintained a remarkable growth and has provided employment for a continually increasing number of Pennsylvania workers. Even in the darkest days of the 1932 depression, employment in printing and publishing was far better maintained than in almost any other branch of Pennsylvania enterprise, and stands today at the highest level it has ever attained.

In our Commonwealth are published more than 560 daily and weekly newspapers and more than 400 magazines or journals. One Pennsylvania newspaper has the largest circulation of any evening newspaper in the United States. Two Pennsylvania magazines are among the most popular in the World. The best known musical magazine in America is published in Pennsylvania, as well as many outstanding legal, medical, scientific, educational, and agricultural periodicals.

Pennsylvania
Manufacturing and Extractive Industries
 Five-Year Averages

<i>Dates</i>	<i>State Totals</i>		<i>Value of Product</i>
	<i>Employment</i>	<i>Compensation</i>	
1916-1920	1,561,610	\$1,820,556,400	\$8,231,312,000
1921-1925	1,486,479	2,005,405,000	7,409,243,600
1926-1930	1,481,526	2,167,024,800	7,574,097,000
1931-1935	1,186,647	1,266,108,500	4,057,580,200
1936-1940	1,361,108	1,745,040,500	6,057,033,000
1941-1945	1,763,792	3,688,946,500	12,795,493,000
1946-1950	1,748,517	4,745,588,300	16,920,731,000

	<i>Operating Ratios</i>	
	<i>Value of Product Per \$1.00 Compensation</i>	<i>Average Annual Compensation Per Employee*</i>
1916-1920	\$4.52	\$1,166
1921-1925	3.69	1,349
1926-1930	3.50	1,463
1931-1935	3.20	1,067
1936-1940	3.47	1,282
1941-1945	3.47	2,091
1946-1950	3.56	2,714

* Includes part-time workers.

Data from Penna. Dept. Internal Affairs.

Percent of Total Employment by Major Industrial
 Classifications

	1920	1929	1933	1940	1943	1950
Total all Industries	100.0	100.0	100.0	100.0	100.0	100.0
Chemicals and Allied Products	2.7	2.5	3.2	2.6	2.8	3.2
Clay, Glass and Stone Products	3.8	3.9	3.4	3.7	3.2	3.8
Food and Kindred Products	4.3	4.9	6.9	6.8	5.7	6.9
Leather and Rubber Goods	2.9	2.3	2.5	2.6	2.1	2.7
Lumber and Its Re-Manufacture	2.1	2.2	1.8	1.8	1.4	2.1
Metals and Metal Products	33.8	31.1	24.5	34.5	41.2	38.9
Mine and Quarry Products	19.7	20.2	19.5	14.2	10.2	9.8
Paper and Printing Industries	3.8	4.8	5.6	5.4	4.1	5.5
Textiles and Textile Products	13.4	18.3	22.7	19.0	14.2	18.4
Tobacco and Its Products	2.5	1.9	1.9	1.3	1.0	.9
Miscellaneous Products	6.0	4.0	4.3	5.2	11.1	5.0
Railroad Repair Shops	5.1	3.9	3.7	2.9	3.0	2.8

Pennsylvania
Manufacturing and Extractive Industries
 Five-Year Averages
 1916—1950
 Major Industrial Classifications

<i>Dates</i>	<i>Employees</i>	<i>Compensation</i>	<i>Value of Product</i>
<i>Chemicals and Allied Products</i>			
1916-1920	47,469	\$56,662,200	\$474,508,000
1921-1925	34,652	51,244,700	391,069,000
1926-1930	36,841	62,345,500	443,443,000
1931-1935	37,194	55,096,600	336,293,000
1936-1940	39,998	67,725,800	464,732,000
1941-1945	49,808	113,026,300	859,149,000
1946-1950	54,540	176,814,000	1,378,455,000
<i>Clay, Glass and Stone Products</i>			
1916-1920	62,709	\$65,145,200	\$180,799,000
1921-1925	58,675	75,979,600	218,381,000
1926-1930	58,248	81,462,600	229,258,000
1931-1935	41,526	39,041,900	111,111,000
1936-1940	49,149	61,809,600	178,696,000
1941-1945	59,003	107,295,900	294,724,000
1946-1950	66,393	176,455,700	477,629,000
<i>Food and Kindred Products</i>			
1916-1920	64,538	\$67,020,300	\$578,538,000
1921-1925	69,188	88,561,300	580,476,000
1926-1930	73,076	103,640,000	640,373,000
1931-1935	78,812	90,511,600	514,345,000
1936-1940	92,862	116,512,300	726,544,000
1941-1945	107,547	172,510,200	1,228,652,000
1946-1950	119,105	275,823,500	2,094,311,000
<i>Leather and Rubber Goods</i>			
1916-1920	39,506	\$36,307,940	\$269,801,000
1921-1925	34,203	39,235,300	198,279,000
1926-1930	31,838	39,169,900	200,949,000
1931-1935	29,009	27,626,900	117,076,000
1936-1940	34,784	36,537,900	166,843,000
1941-1945	39,546	64,613,100	306,129,000
1946-1950	46,172	104,709,500	460,580,000
<i>Lumber and Its Re-manufacture</i>			
1916-1920	35,783	\$33,542,300	\$124,583,500
1921-1925	34,839	43,354,600	133,283,300
1926-1930	33,599	46,377,000	129,935,100
1931-1935	21,614	20,986,900	52,636,300
1936-1940	24,346	25,736,400	72,040,300
1941-1945	27,040	40,447,060	128,127,100
1946-1950	35,747	76,825,700	240,332,000

Five-Year Averages (cont.)
1916—1950
Major Industrial Classifications

<i>Dates</i>	<i>Employees</i>	<i>Compensation</i>	<i>Value of Product</i>
<i>Metals and Metal Products</i>			
1916-1920	554,722	\$745,398,500	\$4,230,830,000
1921-1925	434,496	654,924,900	3,098,696,000
1926-1930	444,123	746,220,160	3,119,364,000
1931-1935	304,752	366,220,920	1,279,869,000
1936-1940	432,783	663,039,660	2,450,624,000
1941-1945	715,504	1,747,893,560	6,196,735,000
1946-1950	683,574	2,080,215,200	7,186,257,000
<i>Mine and Quarry Products</i>			
1916-1920	327,835	\$408,399,840	\$722,535,000
1921-1925	352,918	500,747,000	769,024,000
1926-1930	318,395	460,412,800	705,179,000
1931-1935	235,718	242,234,120	387,886,000
1936-1940	215,492	260,265,280	418,113,000
1941-1945	188,088	406,897,280	733,481,000
1946-1950	180,687	551,472,300	1,028,341,000
<i>Paper, Paper Products, and Printing Industries</i>			
1916-1920	58,899	\$63,325,780	\$244,783,000
1921-1925	64,311	94,446,620	323,124,000
1926-1930	69,763	116,317,060	389,098,000
1931-1935	64,906	91,420,840	276,443,000
1936-1940	73,639	111,814,600	339,062,000
1941-1945	78,003	152,444,220	518,608,000
1946-1950	94,190	278,972,600	904,697,000
<i>Textiles and Textile Products</i>			
1916-1920	214,403	\$161,463,040	\$857,617,000
1921-1925	231,483	237,502,080	1,031,557,000
1926-1930	259,638	299,003,360	1,147,985,000
1931-1935	256,055	212,874,280	667,423,000
1936-1940	272,877	243,615,840	776,700,000
1941-1945	271,835	375,653,540	1,259,602,000
1946-1950	310,874	628,006,000	2,029,466,000
<i>Tobacco and Its Products</i>			
1916-1920	33,740	\$22,060,560	\$84,264,000
1921-1925	37,059	27,445,260	122,441,000
1926-1930	31,527	24,726,040	113,602,000
1931-1935	22,406	13,767,320	63,844,000
1936-1940	20,350	15,024,560	85,972,000
1941-1945	18,382	21,546,820	120,483,000
1946-1950	19,213	31,156,500	152,685,000
<i>Railroad Repair Shops</i>			
1916-1920			\$172,904,000
1921-1925	71,413	\$113,722,740	214,215,000
1926-1930	62,851	102,579,920	183,123,000
1931-1935	44,395	53,964,740	93,061,000
1936-1940	40,112	64,986,000	124,171,000
1941-1945	53,946	123,124,040	208,805,000
1946-1950	48,666	153,176,000	244,017,000

Five-Year Averages (cont.)
1916—1950
Major Industrial Classifications

<i>Dates</i>	<i>Employees</i>	<i>Compensation</i>	<i>Value of Product</i>
<i>Miscellaneous Products*</i>			
1916-1920	88,898	\$106,534,180	\$381,599,600
1921-1925	64,499	80,273,700	293,970,560
1926-1930	60,754	79,958,440	271,790,980
1931-1935	50,261	52,362,320	157,627,700
1936-1940	64,703	77,983,340	245,505,980
1941-1945	155,082	363,494,400	941,007,320
1946-1950	89,365	211,452,400	692,285,000

* "Miscellaneous Products" includes such diverse products as coke, dental supplies, and shipbuilding.

Industrial Data from Pa. Dept. of Internal Affairs.

Pennsylvania
Manufacturing and Extractive Industries
Average Annual Operating Ratios

<i>Year</i>	<i>Employees Per Establishment</i>	<i>Compensation Per Employee*</i>	<i>Value of Product Per \$1.00 Compensation</i>
1926	89	\$1,482	\$3.54
1927	76	1,460	3.41
1928	77	1,467	3.52
1929	79	1,506	3.61
1930	69	1,400	3.38
1931	64	1,215	3.11
1932	58	974	3.02
1933	61	927	3.29
1934	67	1,069	3.24
1935	70	1,125	3.34
1936	76	1,228	3.61
1937	81	1,330	3.57
1938	72	1,184	3.27
1939	77	1,287	3.58
1940	82	1,367	3.51
1941	95	1,617	3.58
1942	102	1,930	3.53
1943	108	2,201	3.47
1944	100	2,380	3.48
1945	91	2,286	3.32
1946	90	2,270	3.26
1947	92	2,634	3.50
1948	86	2,879	3.57
1949	81	2,797	3.60
1950	86	2,985	3.79

* Includes part-time employees.

Retail, Wholesale and Service Trades

The Census of Retail Trade, taken in 1948, showed a total retail sales volume for the State of \$9,069,431,000 reported by 129,896 retail establishments. This represented an increase of 189 percent in sales over 1939 and of 142 percent over the boom year of 1929. In the nine years between 1939 and 1948 there had been a loss of approximately 4600 retail establishments but a gain of 145,400 in employment in retail trade, while sales-per-store were three times as great in dollar value in 1948 as in 1939. Food, eating and drinking places and gasoline stations had the largest number of establishments of any individual branches of retail trade and in sales, food stores led all other types of establishments with a total of \$2,325,372,000, followed by general merchandise stores and stores selling automobiles and automobile supplies.

Philadelphia led the State in total sales and in number of establishments with a total of nearly \$2,118,759,000 in sales in 28,243 retail stores; Allegheny county was second with sales totaling \$1,437,613,000 in 15,291 retail stores. Allegheny county was first in the State in average sales-per-store, but Adams county was first in the percentage increase in total sales since 1939.

Wholesale trade in 1948 reached a total value of \$11,084,459,000 as compared with \$3,347,488,000 in 1939. Wholesale trade in the Commonwealth thus exceeded retail trade by more than two billion dollars. Philadelphia, with a total of more than \$5,700,000,000, and Pittsburgh, with a total of more than \$3,100,000,000, were the leading centers of wholesale trade in the Commonwealth.

Like wholesale and retail business, the service trades showed a great expansion in dollar volume and a considerable growth in employment between 1939 and 1948, the increase in dollar volume being 166 percent during the nine-year interval, while payrolls increased 188 percent and the average receipts per establishment mounted from \$6,893 to \$16,976.

Retail Trade

	1948	1939	1929
Establishments	129,896	134,543	130,631
Sales	\$9,069,431,000	\$3,133,377,000	\$3,747,788,000
Active Proprietors*	131,263	125,532	127,690
Paid Employees—Nov. 15	513,715	368,329	**
Payroll for Entire Year	\$946,602,000	\$338,718,000	\$402,007,000
Average Sales per Store	\$69,821	\$23,289	\$28,690

* Unincorporated businesses.

** Information not available.

	1948		
<i>Kinds of Business</i>	<i>No. Establishments</i>	<i>Sales</i>	<i>Payrolls</i>
Food	42,562	\$2,325,372,000	\$160,721,000
Eating and Drinking Places ..	25,357	740,631,000	115,905,000
General Stores	1,002	79,692,000	6,727,000
General Merchandise	2,805	1,291,184,000	200,349,000
Apparel	10,164	728,194,000	79,320,000
Furniture and Appliances	5,981	507,996,000	69,721,000
Automotive	5,306	1,257,694,000	114,291,000
Gasoline Service Stations	12,117	360,576,000	26,700,000
Lumber, Building Material, Hardware	5,365	562,818,000	67,449,000
Drug	4,261	232,472,000	23,954,000
Liquor Stores and Beer Distributors	1,283	227,133,000	8,269,000
Second Hand Stores	899	15,775,000	2,203,000
All other Retail Stores	12,794	739,894,000	70,993,000

Department Stores

<i>Year</i>	<i>Number</i>	<i>Sales</i>	<i>Annual Payrolls</i>
1948	161	\$948,908,000	\$159,425,000
1939	262	374,934,000	62,567,000
1929	261	455,673,000	67,095,000

Wholesale Trade

	1948	1939	1929
Establishments	14,652	11,450	10,509
Sales	\$11,084,459,000	\$3,347,488,000	\$4,623,429,000
Avg. Sales per Establishment	\$756,515	\$292,331	\$439,950
Payrolls, Entire Year	\$514,558,000	\$169,140,000	\$214,841,000
Active Proprietors* (Nov.)	11,373	8,671	6,119
Paid Employes (Nov.)	157,313	98,972	**
Stocks on hand at end of year	\$570,516,000	\$204,647,000	\$298,920,000
Ratio of Wholesale per \$1 Retail Sales	\$1.22	\$1.07	\$1.23

Wholesale Trade (cont.)
Most Important Wholesale Trade Centers

	<i>Sales</i>	<i>**Ratio of Wholesale to \$1 Retail</i>
Philadelphia	\$5,736,681,000	\$1.71
Pittsburgh	3,107,418,000	1.57
Harrisburg	285,410,000	1.08
Allentown-Bethlehem-Easton	237,564,000	.59
Wilkes-Barre-Hazleton	216,985,000	.71

* Of unincorporated businesses.
 ** For the metropolitan areas.

Service Trades

	<i>1948</i>	<i>1939</i>
Number of Establishments	47,351	45,845
Receipts	\$803,846,000	\$302,278,000
Payrolls, Entire Year	\$233,328,000	\$81,302,000
Active Proprietors (Nov.)	48,470	46,390
Employees (Nov. 15)	130,486	91,697

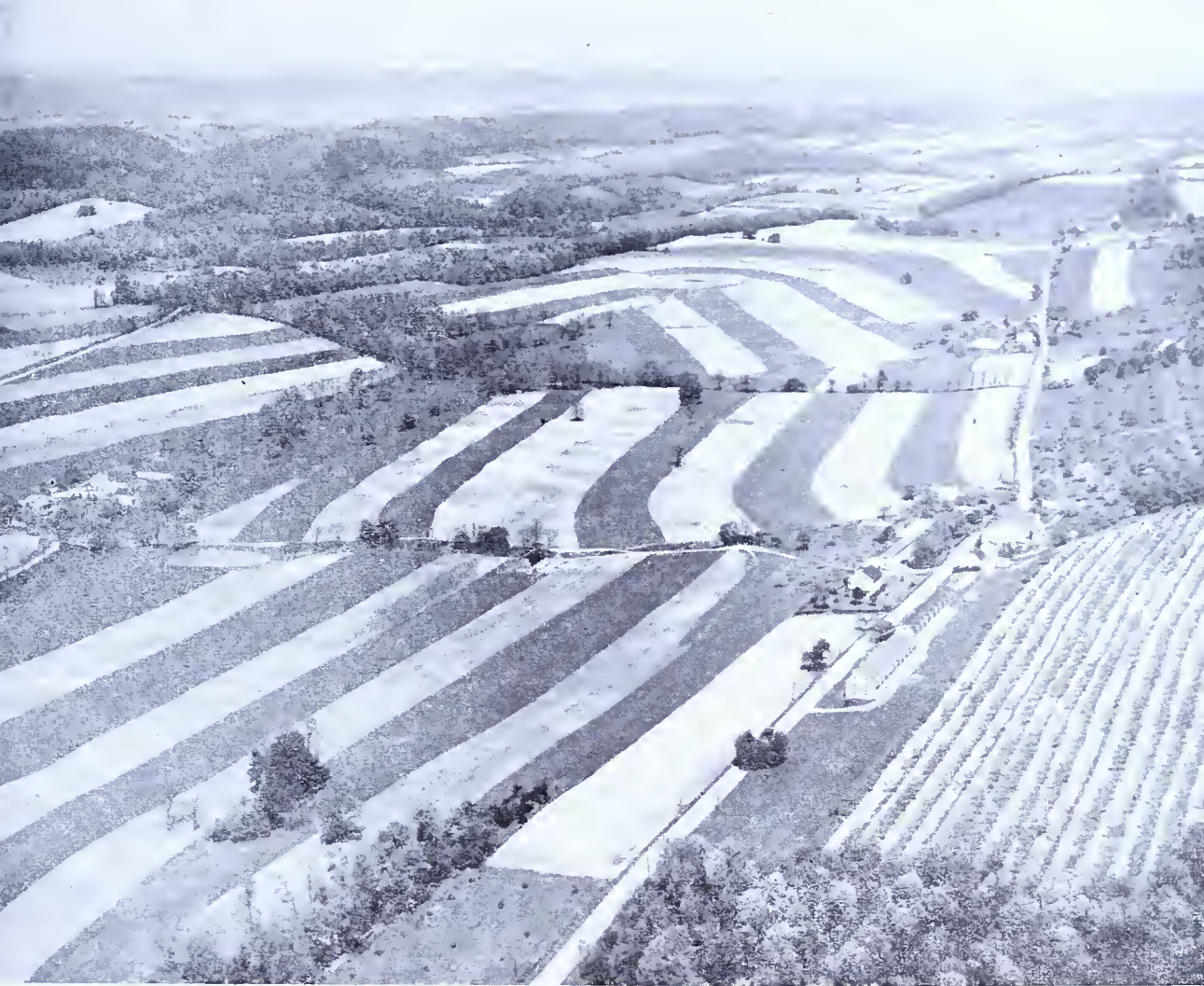
<i>Type of Service</i>	<i>Establishments</i>		<i>Receipts</i>	
	<i>1948</i>	<i>1939</i>	<i>1948</i>	<i>1939</i>
Personal Business and Repair	42,279	41,836	\$540,371,000	\$193,211,000
Amusements	3,442	2,810	143,953,000	67,265,000
Hotels	1,224	1,075	116,939,000	43,572,000
Tourist Courts	406	124	2,583,000	230,000

Average Receipts per Establishment

	<i>1948</i>	<i>1939</i>
All Service Trades	\$16,976	\$6,593
Personal, Business and Repair	12,781	4,618
Amusements	41,822	23,938
Hotels	95,538	40,532
Tourist Courts	6,362	1,855



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Agriculture

Though Pennsylvania is in many respects the greatest industrial State in our Nation and the unquestionable leader in the production of raw materials, the State's farms continue to play a vital part in providing a solid background for its prosperity.

The value of Pennsylvania's farm land and buildings recorded in 1950 in the preliminary report of United States Census of Agriculture was \$1,521,000,000, an increase of 76 percent since 1940. The average value per farm was \$10,349 or \$106.97 per acre for the 14,112,841 acres included in the State's agricultural land. This value per acre compares with \$67 in 1945, \$59 in 1940 and \$54 in 1935. It is the highest value ever reached in the history of the State's agriculture.

Heavy industrial concentration such as that produced by a great war or a period of unusual prosperity generally leads to a decline in the number of farms and the number of persons on farms. There were more than 44,000 fewer farms in 1950 than there were in 1935. This is, however, due in part to a change in the Census definition of farms which has eliminated a great number of small acreage properties and has also increased the average acreage per farm. Before this change in classification there had been a general tendency since 1900 for the number of farms to decline, although the average acreage per farm had shown little change for many years. The figure of 96.1 acres per farm for 1950 can be compared with 87.3 acres in 1920 and 86.8 in 1890. The over-all decline of the land in farms is undoubtedly due to the fact that many submarginal farms have been returned to forest growth during the past 45 years, and that there has been a gradual increase of urban and industrial development in agricultural areas.

Of Pennsylvania's 146,887 farms, the largest number fell within the group containing 100 to 139 acres; 3,835 farms were less than three acres in size; 188 were farms of 1,000 acres or more.

The importance of livestock and dairying on the Pennsylvania farm, illustrated by the splendid showing of dairy cattle at the State Farm Show each year, is also evidenced by the gradual growth in the number of our cows and heifers, which in 1945 had reached a higher point than in any previous Census with a total of 1,011,853. In 1951 there were 1,010,000 cows and heifers on farms.

Pennsylvania's total of \$866,673,000 in 1951 is the highest cash farm income ever recorded in the history of the State. How great the increase in rural prosperity has been in recent years can best be realized by comparing this figure with the \$158,590,000 farm income nineteen years ago in 1932. The value of agricultural production in 1951 is more than five times as great as it was two decades ago.

The State's 1951 income for livestock and livestock products was \$677,978,000, while crops sold for \$188,695,000.

The State leads the Nation in milk sold on the farm, in cigar leaf tobacco, and buckwheat, produces more turkeys than any other state east of the Mississippi, and because of the variety of its production has developed many industries of national importance based on the processing of food. In the city of Pittsburgh is the largest food-packing plant in the Nation and perhaps in the World; in Adams County, the largest apple-processing plant; and in Erie County, the largest grapejuice plant. The State has for many years been first in the production of ice cream, cream cheese, scrapple, and pork sausage.

In the production of mushrooms, one section of Chester County produces 65 percent of the entire United States marketings and is well named the "mushroom center" of the World.

The important fruit crops of apples, peaches, pears, cherries and grapes figure large in the agricultural economy of several of our rural counties.

Lancaster County, Pennsylvania, is first among the 3,069 counties in the United States in the production of tobacco. It is second in the United States in the number of dozens of eggs produced. York County is fourth, Bucks County is thirteenth, and eight other Pennsylvania counties are among the first hundred.

Lancaster County is third in the number of chickens on farms. York County is fourth. Bucks County is eighth, and seven other Pennsylvania counties are among the first hundred. Lancaster County is ninth in the value of all dairy products sold, and six other Pennsylvania counties are among the Nation's leaders.

Only nine counties in the United States exceed Adams County in the number of apple or cherry trees on its farms. Eleven Pennsylvania counties are among the first hundred in the annual harvest of Irish potatoes, and in the number of apple and cherry trees. Erie is the fourteenth county in the United States in the number of grapevines, and Allegheny County, with all of its heavy industrial activity, is among the first hundred counties in the United States in its harvest of cherries, pears, plums, grapes and apples.

Pennsylvania
Agriculture
Production and Yield—Five-Year Averages

	<i>Corn</i>		<i>Wheat</i>		<i>Oats</i>	
	<i>Production (Bushels)</i>	<i>Yield Per Acre</i>	<i>Production (Bushels)</i>	<i>Yield Per Acre</i>	<i>Production (Bushels)</i>	<i>Yield Per Acre</i>
1866-1870	40,409,000	33.9	16,926,000	12.6	31,567,000	29.4
1871-1875	45,422,000	35.5	19,670,000	13.8	28,798,000	25.4
1876-1880	45,097,000	33.3	20,616,000	14.3	35,504,000	28.3
1881-1885	43,180,000	30.9	22,141,000	14.8	34,908,000	27.8
1886-1890	47,548,000	33.8	20,947,000	15.1	33,709,000	25.6
1891-1895	46,018,000	32.5	22,481,000	17.1	32,722,000	26.9
1896-1900	54,302,000	36.0	20,835,000	14.7	33,302,000	28.0
1901-1905	54,933,000	36.1	23,305,000	15.6	34,119,000	28.8
1906-1910	52,662,000	36.4	23,196,000	17.6	32,546,000	28.3
1911-1915	58,651,000	40.1	19,817,000	16.5	34,691,000	31.0
1916-1920	63,742,000	41.4	21,985,000	16.7	37,997,000	32.6
1921-1925	60,071,000	43.8	21,142,000	17.7	31,648,000	29.1
1926-1930	44,871,000	35.8	18,771,000	18.2	30,171,000	30.7
1931-1935	54,600,000	41.0	17,551,000	18.5	25,009,000	26.7
1936-1940	54,960,000	41.1	20,063,000	20.5	26,123,000	30.1
1941-1945	52,988,000	40.0	17,011,000	19.7	24,034,000	28.7
1946-1950	61,418,000	44.8	20,172,000	22.1	26,724,000	34.1
	<i>Potatoes</i>		<i>Tobacco</i>		<i>Hay</i>	
	<i>Production (Bushels)</i>	<i>Yield Per Acre</i>	<i>Production (Pounds)</i>	<i>Yield Per Acre</i>	<i>Production (Tons)</i>	<i>Yield Per Acre</i>
1866-1870	10,299,000	87.0	3,926,000	1,154	2,508,000	1.22
1871-1875	12,261,000	89.0	11,176,000	1,108	2,380,000	1.11
1876-1880	13,581,000	80.0	28,814,000	1,172	3,024,000	1.20
1881-1885	16,515,000	85.0	27,576,000	971	3,512,000	1.23
1886-1890	16,296,000	83.0	29,470,000	1,069	3,744,000	1.23
1891-1895	18,152,000	90.0	30,896,000	1,147	3,512,000	1.23
1896-1900	18,254,000	83.0	35,656,000	1,319	3,821,000	1.22
1901-1905	20,910,000	89.0	33,983,000	1,502	3,875,000	1.25
1906-1910	22,451,000	88.0	54,450,000	1,408	3,848,000	1.27
1911-1915	24,035,000	90.0	54,906,000	1,381	3,734,000	1.24
1916-1920	23,932,000	91.0	60,736,000	1,409	3,859,000	1.31
1921-1925	21,878,000	102.0	57,168,000	1,320	3,687,000	1.22
1926-1930	22,735,000	109.0	47,099,000	1,255	3,392,000	1.26
1931-1935	26,497,000	122.0	35,611,000	1,238	2,946,000	1.21
1936-1940	21,525,000	120.0	41,704,000	1,454	3,056,000	1.30
1941-1945	18,843,000	120.0	47,949,000	1,400	3,548,000	1.43
1946-1950	19,032,000	178.0	60,254,000	1,561	3,584,000	1.47

Pennsylvania
Agriculture

Five-Year Average—Livestock on Farms**

	<i>Horses and Mules</i>	<i>Hogs</i>	<i>Cattle Including Milk Cows</i>	<i>Milk Cows Only</i>	<i>Sheep</i>
1867-1870*	486,500	1,011,500	1,539,500	688,000	2,444,000
1871-1875	526,000	1,071,600	1,695,800	763,000	1,676,200
1876-1880	562,400	1,039,800	1,877,400	813,600	1,661,000
1881-1885	588,400	1,215,800	1,901,000	872,000	2,137,000
1886-1890	618,200	1,145,000	1,922,600	890,400	1,818,000
1891-1895	627,400	1,088,000	1,890,600	913,400	1,632,000
1896-1900	636,600	992,800	1,691,800	932,600	1,057,600
1901-1905	604,400	908,000	1,565,000	947,600	842,800
1906-1910	593,600	818,000	1,481,600	938,200	704,200
1911-1915	591,400	891,000	1,389,400	925,000	586,000
1916-1920	580,000	1,135,200	1,491,800	923,600	489,400
1921-1925	507,600	978,800	1,425,000	901,000	448,200
1926-1930	403,200	738,200	1,301,400	827,600	432,000
1931-1935	351,800	636,600	1,415,200	884,600	474,200
1940***	299,767	515,269	1,333,896	866,936	334,661
1945***	229,202	767,027	1,685,238	1,011,853	278,882
1951***	106,000	704,000	1,808,000	1,010,000	221,000
1952***	97,000	704,000	1,793,000	960,000	235,000

* Four-year average.

** Pennsylvania-Federal Crop Reporting Service.

*** One year only—United States Census of Agriculture.

1951 Production and Value of Specified Crops**

<i>Crop and Unit</i>	<i>Production</i>		<i>Value</i>	
	<i>Amount</i>	<i>U. S. Rank</i>	<i>Amount</i>	<i>U. S. Rank</i>
Corn, bu.	60,766,000	13	\$112,417,000	12
Winter Wheat, bu.	18,832,000	13	39,547,000	13
Oats, bu.	32,340,000	12	29,106,000	12
Barley, bu.	5,416,000	11	6,228,000	12
Rye, bu.	186,000	22	279,000	23
Buckwheat, bu.	944,000	1	1,274,000	1
All Hay, tons	3,530,000	12	90,015,000	10
Cigar Leaf Tobacco, lbs.	56,186,000	1	10,685,000	2
Potatoes, bu.	16,215,000	5	27,566,000	5
Commercial Truck Crops, tons	424,800	12	20,347,000	12
Commercial Apples, bu.	8,200,000	6	8,770,000	6
Peaches, bu.	2,352,000	5	5,057,000	5
Grapes, tons	17,700	5	1,823,000	3
Cherries, tons	15,200	6	2,381,000	6
Maple Sugar, lbs.	22,000	3	16,000	3
Maple Syrup, gals.	98,000	4	431,000	5

Pennsylvania

Agriculture

Livestock and Poultry on Farms, January 1, 1952*

	<i>Number</i>	<i>Value</i>	<i>Farm Value Per Head</i>
Cattle	1,790,000	\$363,370,000	\$203.00
Milk Cows	960,000	253,440,000	264.00
Hogs	704,000	21,894,000	31.10
Sheep	235,000	5,452,000	23.20
Horses and Mules	97,000	7,124,000	73.44
Chickens	26,853,000	49,678,000	1.85
Turkeys	231,000	1,802,000	7.80
Aggregate Value of Livestock and Poultry		\$449,320,000	

* Pennsylvania-Federal Crop Reporting Service.

Number, Averages, Size, Value, and Tenure of Farms

(1950 U. S. Census of Agriculture)

Preliminary Reports

Number of Farms	146,887
Total Farm Acreage	14,112,841
Per cent of State Area	49.0%
Average Acreage Per Farm	96.1
Total Arable Acreage	7,944,850
Percent of Farm Area	56.3%
Total Farm Woodland Acreage	3,423,596
Percent of Farm Area	24.3%
Percent of Farms Tenant Operated	9.4%
Total Value of Land and Buildings	\$1,521,000,000
Average Per Farm Reporting	\$10,349
Average Value Per Acre	\$106.97
Approximate Value of Products Sold	\$545,997,000

Farm Facilities, Jan. 1, 1950

		<i>Per 100 Farms</i>
Automobiles	151,763	103
Trucks	66,113	45
Tractors	125,907	86

Income and Finance

The United States Department of Commerce estimates that 1951 income payments in Pennsylvania amounted to \$17,552,000,000. This is, of course, the highest recorded income during the State's history, and represents an increase of 139 percent over 1929, and a rise of more than \$13,525,000,000 over the low point of 1933.

Changes in recent years, indicated in one of the following tables, are particularly marked by a decline in the percentage of property income to the total, by the relative stability of wages and salaries as a proportion of the total, and by a marked increase in proprietors' income which includes that of farm owners, and in "all other income" including pensions, military allowances, and other forms of Government payments.

Pennsylvania's per capita income is higher than the National average, but, because of our relatively large rural population and the high percentage of women employes in our important textile industries, is lower than that of several Eastern industrial states. It has, however, shown a notable rise during the past ten years.

The listed bank deposits, totaling \$12,454,554,000 as of December 30, 1951, do not include deposits in postal savings banks, or in building and loan associations.

Postal savings deposits totaled \$141,156,000 on June 30, 1951.

Because of the rise in industrial activity in the South and West during recent years, and of the general industrial development of the United States, Pennsylvania's percentage of the total National income has declined as has that of Massachusetts, New York, Illinois, and most of our earlier settled industrial states.

The Federal income estimates show, however, that between 1940 and 1951 Pennsylvania's percentage increase in total income payments (182%) is higher than that for either of the other two Middle Atlantic states, New York and New Jersey, and considerably higher than the average for all the states of the Middle East or New England.

Pennsylvania

Finance

Banking	
Total Banking Institutions December 31, 1951	968
National	619
State	349
Banks	157
Bank and Trust Companies	171
Trust Companies	2
Savings Banks	8
Private Banks	9
Total Bank Deposits, December 31, 1951	\$12,454,554,000
National	7,105,234,000
State	5,349,320,000

Insurance

December 31, 1950

Total Companies Registered in Pennsylvania	1,017
Foreign Companies Registered in Pennsylvania	55
Other States Companies Registered in Pennsylvania	543
Pennsylvania Companies Registered in Pennsylvania	419
Total Fire Insurance Companies	535
Total Casualty Companies	161
Total Life Insurance Companies	140
Total Fraternal Insurance Companies	107
Total Assessment and Reciprocal Insurance Companies	24
Total Title Insurance Companies	30
Total Hospital and Medical Corporations	7
Total Beneficial Societies	13

Pennsylvania
Income
Estimated Income Payments

<i>Year</i>	<i>Total</i>	<i>Per Capita</i>
1929	\$7,338,000,000	\$767
1930	6,638,000,000	688
1931	5,580,000,000	576
1932	4,172,000,000	429
1933	4,027,000,000	414
1934	4,627,000,000	474
1935	4,989,000,000	510
1936	5,818,000,000	594
1937	6,174,000,000	629
1938	5,438,000,000	553
1939	5,819,000,000	589
1940	6,225,000,000	626
1941	7,404,000,000	748
1942	8,822,000,000	907
1943	10,377,000,000	1,104
1944	11,208,000,000	1,213
1945	11,469,000,000	1,264
1946	12,593,000,000	1,286
1947	13,701,000,000	1,368
1948	14,724,000,000	1,441
1949	14,302,000,000	1,374
1950	16,058,000,000	1,523
1951	17,552,000,000	1,663

Source: United States Department of Commerce.

By Type of Payment
(*Amounts in Millions*)

	<i>Wages and Salaries</i>		<i>Proprietors' Income</i>		<i>Property Income</i>		<i>Other Income</i>		<i>Total</i>
	<i>Amount</i>	<i>Percent of Total</i>	<i>Amount</i>	<i>Percent of Total</i>	<i>Amount</i>	<i>Percent of Total</i>	<i>Amount</i>	<i>Percent of Total</i>	
1929	\$4,987	67.96	\$808	11.01	\$1,452	19.79	\$91	1.24	\$7,338
1933	2,594	64.42	404	9.93	831	20.64	202	5.02	4,027
1939	3,760	64.62	627	10.77	979	16.82	453	7.79	5,819
1940	4,148	66.63	692	11.12	978	15.71	407	6.54	6,225
1941	5,201	70.25	853	11.52	1,014	13.69	336	4.54	7,404
1942	6,422	72.80	1,045	11.84	1,052	11.92	303	3.44	8,822
1943	7,501	72.29	1,374	13.24	1,089	10.49	413	3.98	10,377
1944	7,870	70.22	1,543	13.77	1,131	10.09	664	5.92	11,208
1945	7,715	67.27	1,655	14.43	1,164	10.15	935	8.15	11,469
1946	8,278	65.74	2,000	15.88	1,310	10.40	1,005	7.98	12,593
1947	9,537	69.61	1,881	13.73	1,429	10.43	854	6.23	13,701
1948	10,510	71.38	1,967	13.36	1,485	10.08	762	5.18	14,724
1949	10,140	70.90	1,700	11.88	1,547	10.82	915	6.40	14,302
1950	10,959	68.25	1,962	12.22	1,734	10.80	1,403	8.73	16,058
1951	12,578	71.66	2,164	12.33	1,816	10.35	994	5.66	17,552



Old Main at Pennsylvania State College



The Benjamin Franklin Parkway at Philadelphia

Education, Churches, Arts

The U. S. Census reports a total of 101 institutions of higher learning in the State of Pennsylvania—a number not surpassed in any other state. This includes 14 State Teachers Colleges and The Pennsylvania State College, as well as such nationally famous institutions as the University of Pennsylvania, the first American University, founded by Benjamin Franklin in 1749.

The Women's Medical College, opened in 1850, was the first Women's Medical School in the world. Institutions founded before 1800 include the University of Pittsburgh, now housed in its "Cathedral of Learning," the world's most dramatic example of an educational structure, Dickinson College and Washington and Jefferson

College. The Pennsylvania Academy, founded in 1805, was the first American school of the Fine Arts.

The list of the State's institutions of learning, both in the field of general and technical education, is too long for inclusion in this brief summary, but contains the names of many colleges and institutes of national and international reputation.

The State's 7,875 public schools employed in 1949 61,242 supervisors and teachers, and had an average daily attendance of nearly 1,504,000.

For the 1951-1953 biennium the General Assembly appropriated a total of \$409,487,787 for public education. This includes large appropriations to assist school districts in the payment of salaries, to provide transportation for school children and to support the education of the handicapped.

The State also maintains the fourteen State Teachers Colleges, makes appropriations for buildings, maintenance and research at The Pennsylvania State College and assists in the operation of many other educational institutions. It also contributes its matching share of payments to the Teachers Retirement Fund and provides aid to free public libraries.

The tradition of religious tolerance, fundamental in the philosophy of William Penn, has led to the establishment in Pennsylvania of churches of almost every American religious denomination. The first Quaker Meeting in Pennsylvania was held in 1675—seven years before Penn's landing in Philadelphia. In 1682 the first American Mennonites settled in Germantown and spread later into Bucks, Berks, Lancaster, and Northampton Counties, establishing large communities of the Plain People.

Old Swedes' Church, Pennsylvania's earliest example of fine but simple church architecture, was completed in 1700 by a Lutheran congregation. Christ Church in Philadelphia, the present edifice of which was completed in 1754, still possesses a communion service presented by Queen Anne of England.



Christ Church in Philadelphia completed in 1754

The Episcopalians first held services in the colony in 1695. The State's earliest Baptist Church was organized in 1684. The Presbyterians held their earliest services in 1692 and the Methodist congregations date their beginning in Pennsylvania to the efforts of a British Army Officer, a convert of John Wesley. Their first church was established in 1768.

The first Roman Catholic Parish in Pennsylvania was that of St. Joseph's in Philadelphia, established between 1731 and 1733. The present Church of St. Joseph's in Willings Alley stands on the site of the early colonial structure. In 1782 Pennsylvania's first Jewish Synagogue was dedicated.

The buildings of the Harmony Society at Ambridge, north of Pittsburgh, and those at Ephrata in Lancaster County, are memorials to two of the most interesting of the many religious bodies whose people sought refuge in Pennsylvania for the practice of their faiths.

Today with more than five and a half million church members and more than two million Sunday School teachers and pupils, Pennsylvania has more churches than any other state and still retains congregations of almost every one of the many sects which took shelter in this colony in those long-ago years of religious persecution.

Pennsylvania has always occupied an important place in American art, literature and invention. The first novelist of our Nation, Charles Brockden Brown, was a Pennsylvanian. Edgar Allan Poe and Walt Whitman were intimately associated with the city of Philadelphia at the height of their literary careers. The first great American painter, Benjamin West, was a Pennsylvanian. Thomas Eakins, one of America's masters, was first a student and afterwards a teacher at the Pennsylvania Academy of Fine Arts. Henry O. Tanner, the great negro painter of Biblical scenes, was a Pennsylvanian.

Exhibitions held at the Pennsylvania Academy of Fine Arts, the first such institution ever established in America,



The University of Pittsburgh's Cathedral of Learning

at the Carnegie Institute in Pittsburgh and in many other art museums of the State, are of national and international interest.

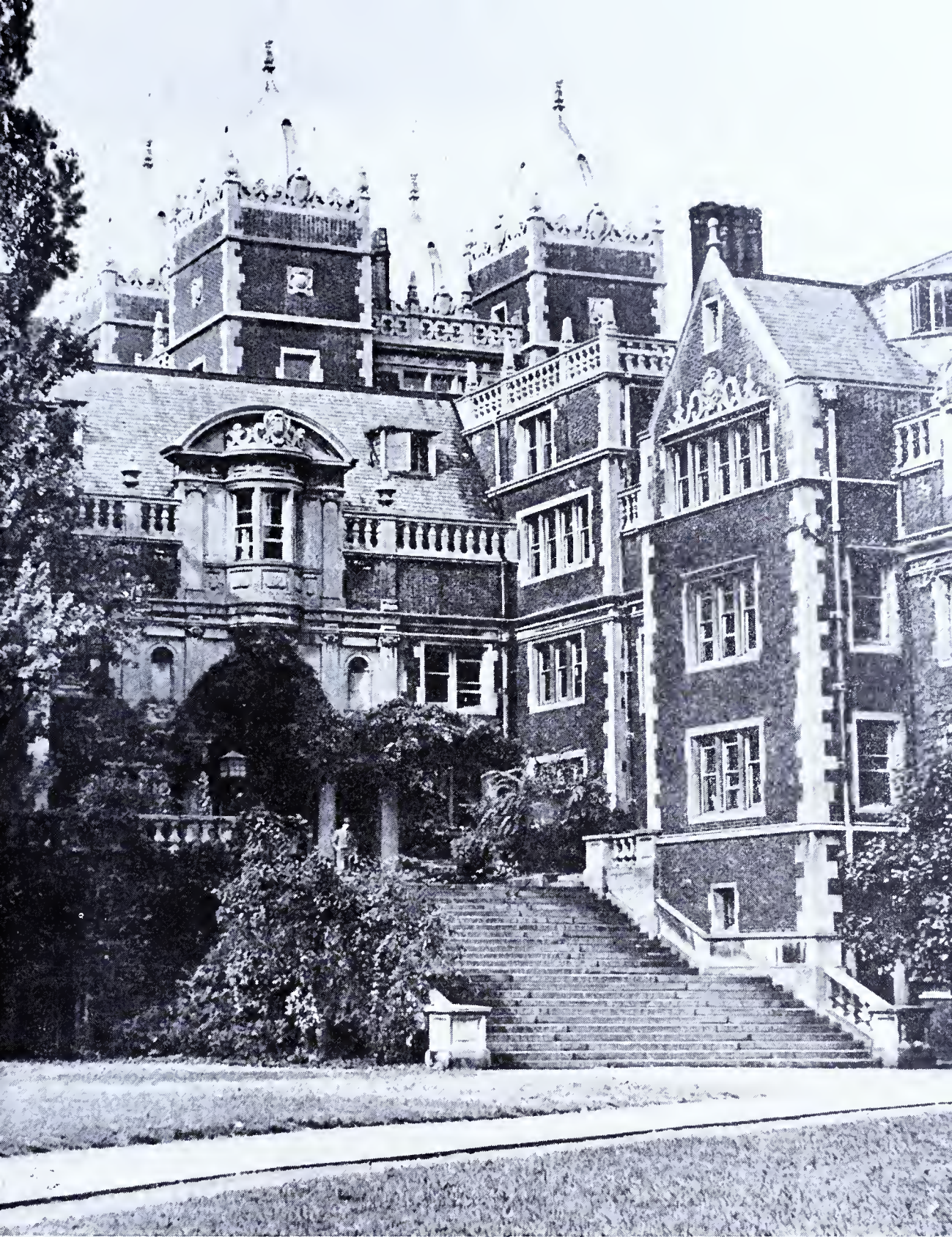
Other evidences of the important influence of the cultural traditions of the Commonwealth are the notable contributions made by Pennsylvania collectors to the National Gallery of Art, which was made possible by the bequest to the Nation by Andrew Mellon of the building and of his World-famous collection of masterpieces, and by the notable gifts of paintings and sculpture by two other Pennsylvanians, Samuel H. Kress and Joseph Widener.

The Pennsylvania State Capitol at Harrisburg, which with its adjoining buildings forms the most impressive group of state government structures in America, contains many examples of the work of outstanding Pennsylvania painters and sculptors.

Flanking the main entrance to the Capitol building are two symbolic groups in white marble by one of America's leading sculptors, George Gray Barnard, a native son of Pennsylvania. Four large lunettes in the Capitol rotunda and two large symbolic paintings in the chamber of the House of Representatives were painted by Edwin Austin Abbey, another Pennsylvanian, whose "Holy Grail" series in the Boston Public Library has given him a high place among modern muralists.

Miss Violet Oakley, America's most distinguished woman mural painter, has decorated the Senate Chamber, the Supreme Court Room and the Governor's Reception Room in the Capitol. She also is a Pennsylvanian.

Among a host of recent or contemporary Pennsylvania painters, some of the best known are Edward W. Redfield, W. Elmer Schofield and Daniel Garber of the Delaware River School, John W. Alexander, Cecilia Beaux, George Biddle, Arthur Carles, William Glackens, Robert Henri, George Luks, Maxfield Parrish, Hobson Pittman, Francis Speight, Franklin Watkins and N. C. Wyeth. R. Tait McKenzie of Philadelphia, sculptor of American athletes, created many monumental war memorials.



A corner in the dormitories of the University of Pennsylvania

The modern primitive school of American painting began with the landscapes of John Kane, a self-taught Irish house painter of Pittsburgh. Throughout a lifetime of hard manual work he painted, with great freshness and power, scenes of the industrial life of western Pennsylvania and in competition with the leading artists of the world gained first place at the Carnegie International Exhibition.

Among leading American illustrators Pennsylvanians also have a high place. Joseph Pennell, greatest American lithographer and etcher of industrial scenes, Thornton Oakley and George Harding, who are both muralists and illustrators, are widely known.

In a recent renaissance of American handcrafts the contribution of our early Pennsylvania-German settlers to the art traditions of America has been recognized as of first importance.

A list of Pennsylvania's distinguished writers would be too long for this brief survey but should at least include Louisa M. Alcott, the author of "Little Men" and "Little Women," who was born in Germantown; Bayard Taylor; Dr. S. Weir Mitchell, a great neurologist, who wrote one of America's outstanding historical novels, "Hugh Wynne, Free Quaker"; John Luther Long, the author of "Madame Butterfly"; Agnes Repplier; Owen Wister, whose "Virginian" began a new type of Western novel; Joseph Hergesheimer; Willa Cather; John T. McIntyre; Christopher Morley; and Stephen Vincent Benet, a native of Bethlehem, whose "John Brown's Body" was a distinguished achievement in narrative poetry.

Among the State's better known composers are Ethelbert Nevin, Charles Wakefield Cadman and Henry Thacker Burleigh. Stephen Collins Foster of Pittsburgh is America's greatest song writer.

The Philadelphia Symphony Orchestra is among the best in the world, but several other Pennsylvania cities support orchestras which have added greatly to the high

place Pennsylvania has always occupied in the musical world. The annual Bach Festival held each May at Bethlehem is an event of international importance.

Pennsylvania
Education

Public Schools

<i>School Year 1949-1950</i>	
School Buildings	8,057
School Districts	2,530
Teachers and Supervising Officials	61,242
Total Enrollment	1,558,602
Average Daily Membership	1,503,988
Total Current Expenses (Less Tuition)	\$282,020,621
Current Expenses per Average Daily Membership	\$187.52

Other Schools and Colleges
1950

Private and Parochial Schools (Estimated) ..	550
Enrollment	340,000
Colleges and Universities (Including four Theological Seminaries)	76
State Teachers Colleges	14
Junior Colleges	11

Churches (1936)

	<i>Total</i>	<i>Urban</i>	<i>Rural</i>
Churches	13,461	6,523	6,938
Members	5,412,246	4,275,051	1,137,195
Average Members Per Church ..	402	655	164

Libraries and Museums (1950)

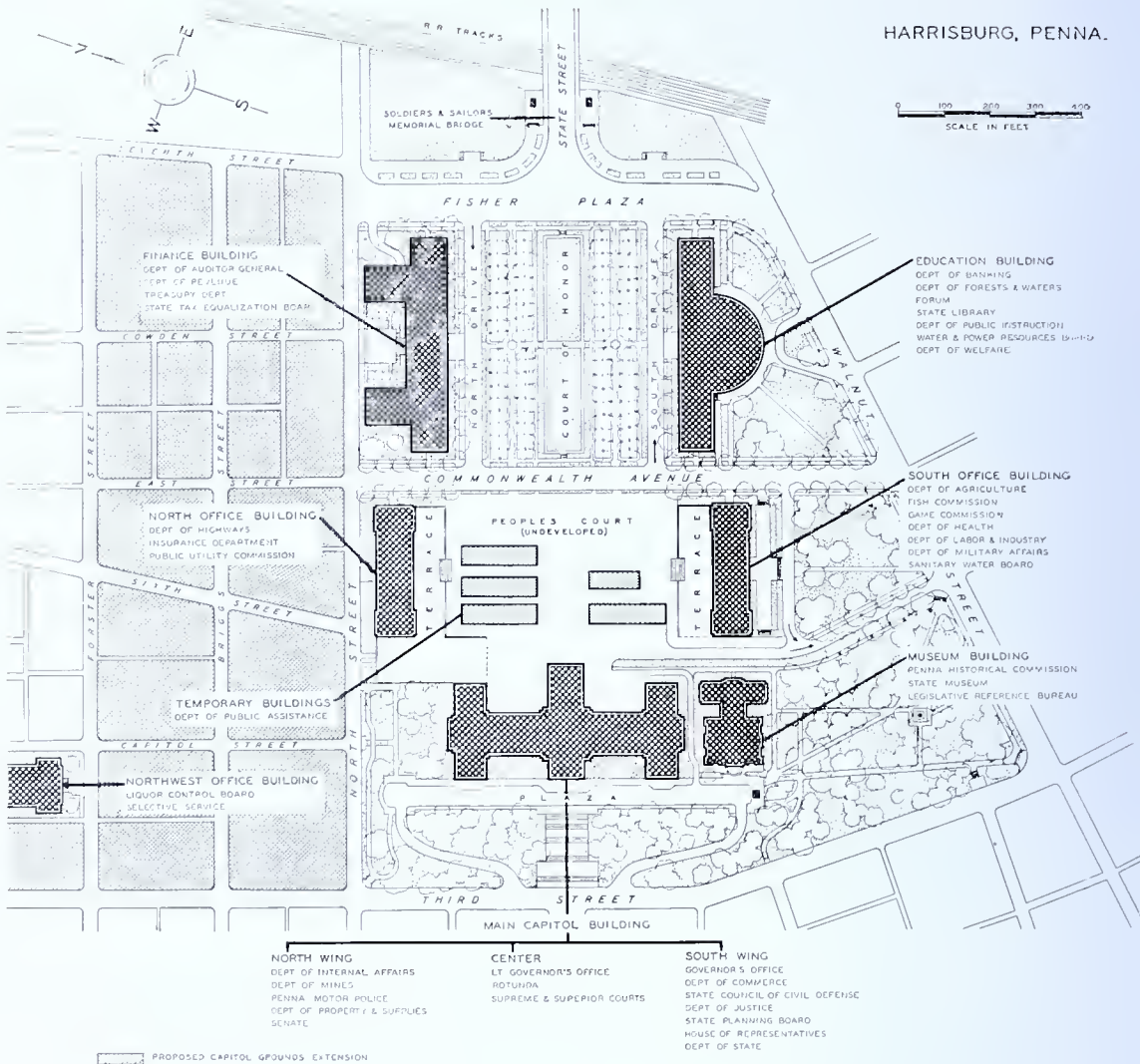
Public Libraries (Approximate)	355
Museums (Approximate)	150

Health (1951)

Hospitals	347
Licensed Physicians	15,987
Registered Nurses	73,047
Licensed Dentists	7,373
Licensed Dental Hygienists	1,000

PENNSYLVANIA STATE CAPITOL GROUP

HARRISBURG, PENNA.



The Pennsylvania State Capitol dominates what is probably the most impressive group of buildings housing any state government in our country. In the plan shown above, the location and something of the variety of activities and interests of the government of our Commonwealth are indicated. The area north of the Capitol group, shaded in the plan shown above, is being acquired for use as a public park and as a site for additions to the Capitol buildings.



The Pennsylvania State Capitol

State and Local Government

Pennsylvania's State Government operates under the Constitution adopted at an election held in 1873. This document has been frequently amended, but has remained in effect longer than any other constitution ever adopted by the Commonwealth. In the American form of government, all power originally stemmed from the thirteen states which formed the Federal Union. Those states granted to the United States Government all the basic powers which it now possesses, but reserved to themselves, and to the people, all other governmental authority.

In Pennsylvania the power of self-government is granted to counties, cities and other civil sub-divisions only through the State. Amendments to the State Constitution must be

agreed to by a majority of each House in two successive General Assemblies and afterwards ratified by a vote of the people.

Constitutional Requirements for Public Office

Certain qualifications are required by the Constitutions of the United States and of the Commonwealth of Pennsylvania for many of the more important public offices. Since the several political parties make certain their candidates qualify for these offices before nomination, relatively few persons are familiar with the mandatory requirements.

The Governor and Lieutenant Governor of our State must be at least thirty years of age. They must have been inhabitants of the State for at least seven years immediately preceding their election, unless they had been absent during that time on public business of the Federal or State Governments, and they must be citizens of the United States. Their term is four years and they are not eligible to the same office for the next succeeding term. Including Pennsylvania, twenty-five states now have four-year terms for their Governors. Twenty-three have two-year terms.

The Senators elected to Congress must be at least thirty years of age, nine years citizens of the United States, and inhabitants of the state in which they were chosen. Their term of office is six years. United States Representatives must be twenty-five years of age, have been citizens of the United States for seven years and also inhabitants of the states in which they were chosen. Their term of office is two years.

Senators elected to the State Legislature are required to be at least twenty-five years of age. Representatives must be at least twenty-one. They must have been citizens and inhabitants of the State four years, and inhabitants of their respective districts one year immediately preceding their election unless absent on public business of the United States or the Commonwealth. The term of office for a State Senator is four years and for a State Representative two years.

The Duties of the Governor

The Governor of Pennsylvania has heavy responsibilities. At each regular meeting of the General Assembly the Governor must submit a State Budget recommending amounts to be appropriated for each of the State agencies and for all other special purposes. He must also submit estimates of receipts from all sources and the amount necessary to be raised by taxation. Once appropriations have been made, the Governor, through his Budget Bureau, exercises a close month by month control over expenditures. The Governor also must approve or disapprove all proposed investments of State custodial funds.

Apart from these financial powers which are of first importance to the economic stability of the State Government, the Governor, under the Constitution, has the power to appoint, with the approval of two-thirds of the Senate, all administrative officers of the Commonwealth, to fill vacancies in judicial or other offices, to grant reprieves and pardons except in cases of impeachment, to convene the General Assembly for emergency action, to adjourn the General Assembly if the two Houses disagree as to the time of adjournment, to approve or veto legislation passed by the Assembly, to disapprove or reduce items of any appropriation bill, and to act as Commander-in-Chief of the State's armed forces.

The Governor grants licenses to notaries public and issues charters for credit unions, cooperative associations and insurance companies.

In addition to these many duties the Governor is also required, under the Constitution, to give to the General Assembly on its meeting a report as to the state of the Commonwealth and to recommend needed legislation.

Departments, Boards, and Commissions in the State Government

Besides the Governor and the Lieutenant Governor, who is the President of the State Senate, twenty executive departments and many boards and commissions are required

to carry out the complex duties of maintaining the general welfare and protecting the citizens of our Commonwealth.

Three of the heads of executive departments are elected by popular vote. The Auditor General and the State Treasurer are elected in the years of the General Presidential Election. The Secretary of Internal Affairs, like the Governor and the Lieutenant Governor, is elected in the intervening even-numbered years. Neither the Auditor General nor the State Treasurer can succeed himself in office.

Other departments of the State Government, each headed by a Secretary with the exception of the ones noted below are those dealing with Agriculture, Banking, Commerce, Forests and Waters, Health, Highways, Insurance which is headed by the Insurance Commissioner, Justice which is directed by the Attorney General, Labor and Industry, Military Affairs which is headed by the Adjutant General, Mines, Property and Supplies, Public Assistance, Public Instruction which is headed by the Superintendent of Public Instruction, Revenue, State which is headed by the Secretary of the Commonwealth, and Welfare.

In addition to these twenty departments there have been established the following important agencies: the Civil Service, Game, Fish, Historical and Museum, Milk Control, and Public Utility Commissions; the Pennsylvania Liquor Control Board; the Board of Parole; the Tax Equalization Board; the Pennsylvania State Police and the State Council of Civil Defense.

There are also several quasi-government commissions such as the Pennsylvania Turnpike Commission; the General State Authority; the State Highway and Bridge Authority and the State Public School Building Authority.

Many other boards and commissions function within the various departments, such as the State Farm Products Show Commission and the State Soil Conservation Commission in the Department of Agriculture; the Pennsylvania Securities Commission in the Department of Banking; the State Planning Board and the Pennsylvania Aeronautics Commission in the Department of Commerce; the Water and

Power Resources Board in the Department of Forests and Waters; the Sanitary Water Board in the Department of Health; the Board of Pardons in the Department of Justice; the Workmen's Compensation Board, the State Board of Vocational Education, the Pennsylvania State Employment Service, the Labor Relations Board, the Industrial Board, and the State Workmen's Insurance Fund in the Department of Labor and Industry; the State Veterans Commission in the Department of Military Affairs; the Pennsylvania Art Commission and the Capitol Park Extension Commission in the Department of Property and Supplies; the Professional Examining Boards, the Public School Employees' Retirement Board, the State Board of Censors, the State Council of Education, and the State Library in the Department of Public Instruction; the State Athletic Commission in the Department of Revenue; the State Employees' Retirement Board in the Department of State; the Board of Finance and Revenue in the Treasury Department; and the State Council for the Blind in the Department of Welfare.

Many of these boards and commissions, whether independent or departmental are composed chiefly, or in part, of non-paid citizen members appointed by the Governor. Certain commissions have members representing both the Legislative and Executive Branches. Chief among these are The Commission on Interstate Cooperation, the Interstate Commission on the Delaware River Basin, the Ohio River Valley Sanitation Commission, and the Interstate Commission on the Potomac River Basin.

The Legislative Reference Bureau, the Joint State Government Commission, and the Local Government Commission are among the agencies of the General Assembly.

In addition to these diverse and necessary fields of our government activity are various State institutions. These include the fourteen State Teachers Colleges, the State Oral School for the Deaf, the Scotland School for Veterans' Children, the Thaddeus Stevens Industrial School, the Penal and Correctional Institutions, the Medical and Surgical Hospitals, the Mental Hospitals, the Hospitals for

Feeble-Minded and Epileptic, the Eastern Pennsylvania Psychiatric Institute, the Western State Psychiatric Institute and Clinic, the Armories, the State Arsenal, the Soldiers' and Sailors' Home, the State's Laboratories, the three Tubercular Sanatoria, and the State Hospital for Crippled Children.

The Pennsylvania State College is the agency of the Commonwealth for carrying out the terms of the Land Grant College Act.

Various agencies of the State Government administer large areas of land totalling nearly 2,864,000 acres, or one-eleventh of the State's total area.

The Work of the Legislature

Our present Constitution vests all law-making authority in a General Assembly consisting of two bodies—the Senate and the House of Representatives. The members of the State Senate are elected for a term of four years, the members of the House of Representatives for a term of two years, as noted on Page 80.

The State is divided into fifty Senatorial Districts as nearly equal in population as possible. No county is entitled to a representation exceeding one-sixth of the whole number of senators. Under this provision, Philadelphia, however great its population, can elect no more than eight senators, and that is the number now representing it at Harrisburg.

Although the members of the House are apportioned among the counties on a ratio obtained by dividing the population of the State by 200, there are now 208 representatives in the General Assembly. This arises from the fact that under the Constitution each county having less than five ratios may have one representative for every full ratio and an additional representative when the surplus exceeds one-half a ratio; and also that each county, whatever its population, shall have at least one representative. One-two-hundredth of the State's population is now approximately 50,000 people, but there are several counties in Pennsylvania with a population of less than 8,000. Con-

sequently, a larger number than was originally contemplated now represent us in our present General Assembly.

The Lieutenant Governor of the State is the presiding officer of the Senate, but has a vote only in case of a tie on a parliamentary motion. He has no vote in the enactment of legislation itself, regardless of tie votes.

The Speaker of the House, elected by its members from among their own number, has no limitation on his right to vote.

Before a bill is introduced in either the House or the Senate, it is usually drafted into the accepted form by the Legislative Reference Bureau. If it is a House bill it is then signed by the member sponsoring the measure and filed with the Chief Clerk of the House. In the Senate the bill is presented by the senator directly to the presiding officer.

In either case, the bill is then referred by the Speaker or the President of the Senate to an appropriate committee for consideration, and is not acted upon until that committee approves or amends it and returns it to the floor.

Once every week a History is printed for both the Senate and the House, showing the action taken on every bill presented to the Assembly.

A large part of the work done by the Legislators is that of serving on the many committees which determine the advisability of recommending for legislative action the more than 2,000 bills presented to the General Assembly during each biennial session.

The Higher Courts

Pennsylvania has two higher judicial bodies, the Supreme Court and the Superior Court. The members of the Supreme Court are called Justices, with one of their number designated as the Chief Justice. The members of the Superior Court are called Judges, headed by a President Judge.

The Supreme Court was originally created by the Provincial Assembly on May 22, 1772, long before the

adoption of our present State Constitution. At that time it was provided that the Court should consist of one Chief Justice and two Associate Justices. In the following years until 1876, the number of Justices, as provided by law, varied from three to five. Since 1876, however, the number has remained at seven. At first, the Justices were generally appointed by the President of the Provincial Council and their terms of office varied from a few years to life. In 1850, by Constitutional Amendment, their offices were made elective and in 1876, their term was fixed at 21 years, with the provision that they are not eligible for re-election. This term of office and manner of selection has prevailed ever since.

The Superior Court, which is also composed of seven members, was not provided for by the Constitution. It was created in 1895 by the General Assembly because it was becoming difficult for the Supreme Court to handle the increasing volume of legal business. The Judges of this body are elected for a term of 10 years and may seek re-election.

The Supreme Court is the final tribunal to which an appeal may be made in civil cases when the amount in controversy exceeds \$2500 and also in cases of felonious homicide. The Superior Court has final jurisdiction in civil cases in which the amount involved does not exceed \$2500 and also in all criminal cases except felonious homicide. The Superior Court hears appeals involving the Public Utility Commission and Workmen's Compensation cases.

Local Government

Since under the State Constitution the passage of local or special laws by the General Assembly is forbidden, it has been necessary to divide the counties of the State into eight classes on the basis of population, and to create four classes of cities.

Each of our State's 66 counties is governed by a Board of three County Commissioners.*

* Until 1951, Philadelphia was listed as the State's only First-Class County, but its county and city governments were consolidated by Act of the General Assembly, 1951.

There is one first-class city (Philadelphia), one second-class city (Pittsburgh), and one second-class A city (Scranton). Although their populations vary from 130,803 in 1950 for Erie, to 7,911 in the same year for Corry, all other cities but one, are listed in the third class. The exception is Parker City, population 979 in 1950, which was incorporated in 1873 by a special Act of the Legislature. All cities are governed by a Mayor and a City Council.

Several of the boroughs are larger than most of our third-class cities. The largest borough is Norristown with a population of 38,126. The smallest borough at the time of the last Census was Livermore with a population of 57.

Boroughs are governed by a burgess and a borough council.

There are two types of townships—those of the first class, governed by township commissioners, of which Upper Darby (84,951) is the most populous, and those of the second class, governed by township supervisors. The largest township of the second class is Hempfield, with a population of 22,463; the smallest is Barclay in Bradford County, with a population of 3 in 1950.

In addition, there is one community in the Commonwealth officially incorporated as a town. That is Bloomsburg, the population of which in 1950 was 10,633.

The government of Bloomsburg is similar to that of the boroughs, but the president of the council performs most of the functions of a burgess.

The second-class townships have the most limited governmental powers. They are usually in rural areas and much of the authority over their territory is exercised by their county commissioners.

If a township of the second class has a population of three hundred per square mile, and its inhabitants so elect, it can become a township of the first class with increased powers of local self-government.

There is one Indian Grant, the Cornplanter State Indian Grant in Warren County, with a population of 17.

Pennsylvania

State Government Personnel and Civil Subdivisions

Executive	
<i>Elected</i>	<i>Term</i>
Governor	4 years
Lieutenant Governor	4 years
Auditor General	4 years
State Treasurer	4 years
Secretary of Internal Affairs	4 years
<i>Appointed</i>	<i>Number</i>
Department Secretaries, Board Directors, and Commission Chairmen	72
Permanent State Employees—April, 1951	45,800
Total, Including Employees of State Teachers Colleges and The Pennsylvania State College	65,400
Legislative	
State Senators	50
State Representatives	208
(The Legislature convenes the first Tuesday of January in the odd numbered years.)	
Judiciary	
<i>Supreme Court</i>	
Chief Justice	1
Associate Justices	6
Prothonotaries (Serve both Supreme and Superior Courts)	3
Deputy Prothonotaries (Serve Both Supreme and Superior Courts)	3
State Reporters	2
<i>Superior Court</i>	
President Judge	1
Associate Judges	6
Civil Subdivisions	
Counties	66
Cities	51
Boroughs	938
Town	1
First Class Townships	63
Second Class Townships	1,508
School Districts	2,530
Post Offices	2,407

SELECTED PUBLICATIONS OF THE PENNSYLVANIA STATE PLANNING BOARD

Publication
No.

- 1—Preliminary Report. 682 pages. 152 charts, December, 1934.
- *10—Drainage Basin Study. 3 vols., 611 pages, 1937.
- 17—Industrial Utility of Water in Pennsylvania. Chemical Character of Surface Water, 1944 to 1946. 1947.
- 18—The Pennsylvania Zoning Primer (Revised), 1948.
- 19—Local Powers for Community Development, 1948.
- 20—A Pennsylvania Recreation Manual, 1949.
- 21—Planning and Zoning Powers and Procedures in Pennsylvania, 1949. Vol. 1. (Townships of the Second Class, Counties, Regions.)
- 22—Planning and Zoning Powers and Procedures in Pennsylvania, 1949. Vol. 2. (Cities, Boroughs, First Class Townships.)
- 23—Industrial Utility of Water in Pennsylvania, 1946-1949. 1952. (A supplement to Pub. No. 17.)
- 24—Aerial Photographs as Tax Maps, 1952.
- 25—An Economic Background for Regional Planning in the Anthracite Area, 1952.

These publications may be seen in representative public libraries. A limited number of those listed are available for distribution until the present supply is exhausted. Those marked with an asterisk are now out of print but may be seen in representative public libraries.

The following issues of **Pennsylvania Planning** are still available.

- Population, October, 1942.
- Handicrafts in Post-War Planning, May, 1943.
- Plastics, July, 1943.
- Air Photographs, February, 1944.
- Light Metals and Stainless Steel, August, 1944.
- Topographic Mapping Needs, February, 1945. (For limited technical distribution.)
- Community Action for Local Self Development, July, 1945.
- Forest Resources, November, 1946.
- Soil Conservation, September, 1947.
- Minerals Conservation, December, 1948.
- Comparative County Data, August, 1950.
- Report and Program, January, 1951.
- Pennsylvania Anthracite, March, 1952.

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PENNSYLVANIA BITUMINOUS COAL

PENNSYLVANIA PLANNING JUNE 1953



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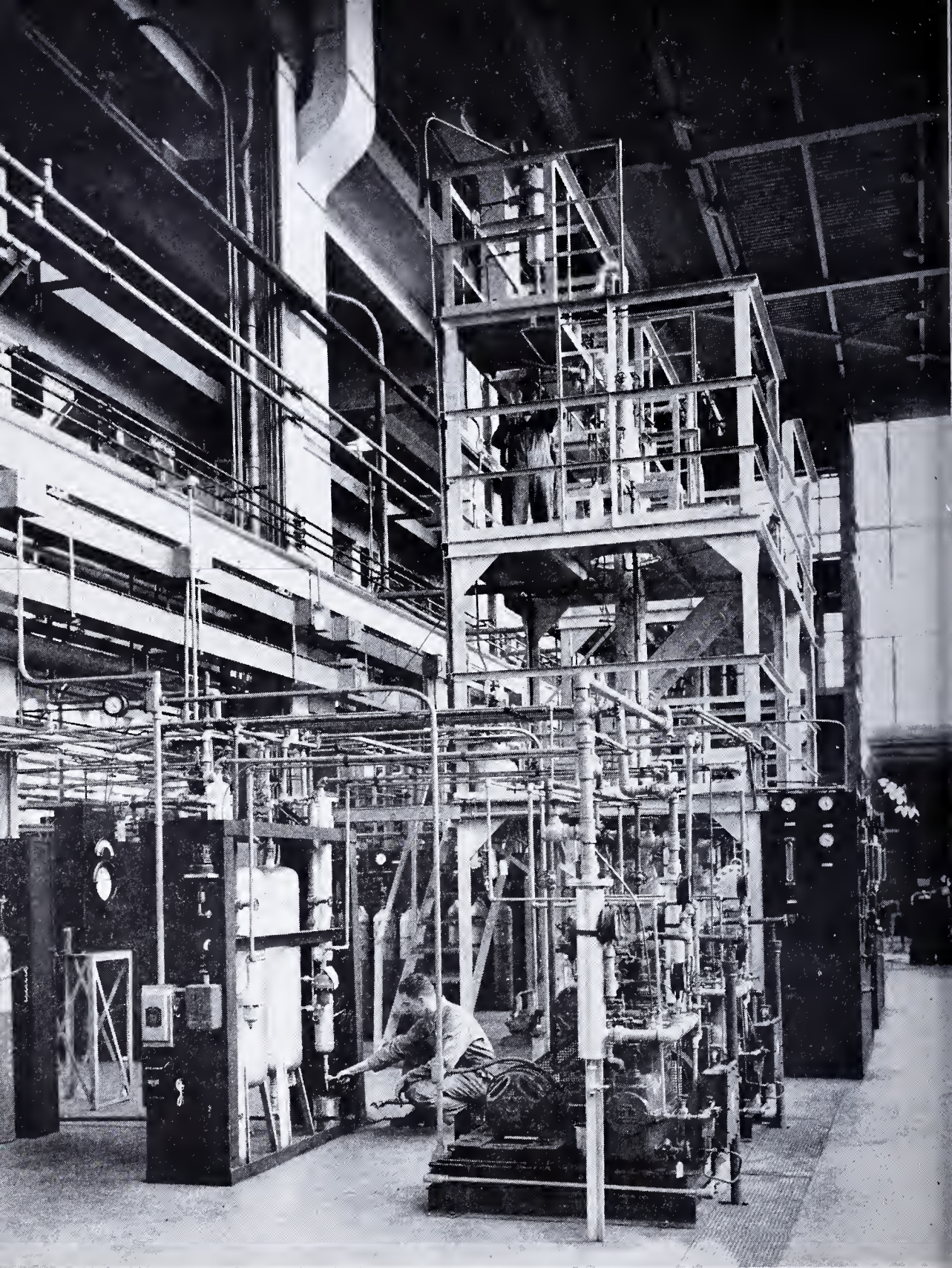


Research and Planning Associates
Paul B. Gensemer Mary L. Moody

*Pennsylvania
Bituminous
Coal*

Commonwealth of Pennsylvania
State Planning Board
Department of Commerce
1953

P38.49



This Fisher-Tropsch pilot plant of the U. S. Bureau of Mines at Bruceton, Pennsylvania, is developing the possibilities of bituminous coal as a source of liquid fuel.

Pennsylvania Planning

To inform those who
are interested and
to interest others.

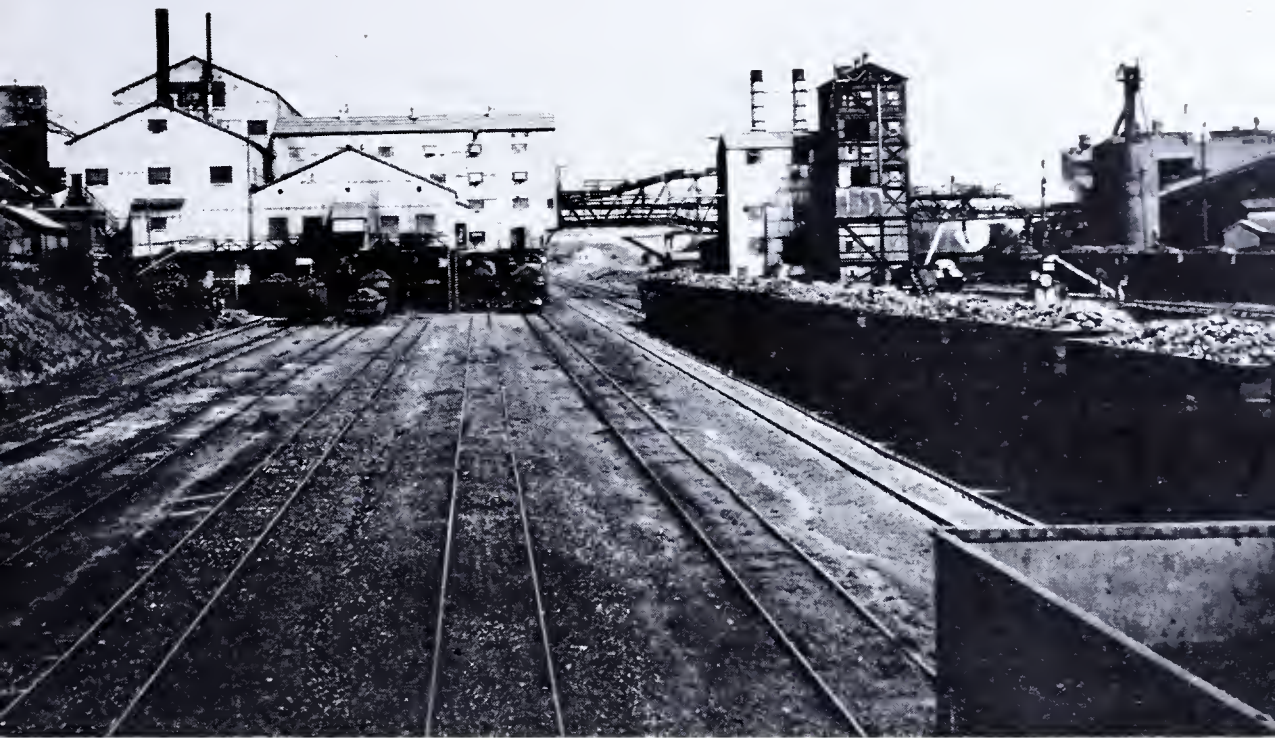
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This Pennsylvania preparation plant has a daily capacity of 15,000 tons of cleaned coal.

Introduction

Two thousand years ago a Greek scholar spoke of coal as the Lipara stone that "empties itself, as it were, in burning, and becomes like the pumice, changing at once both its color and density; for before burning it is black, smooth, and compact."

From those early days when coal was regarded as a curiosity to today, technologic advances have made coal the base upon which our industrial civilization rests. That this base has expanded over the past 60 years is evident at once upon consideration of the fact that Pennsylvania's coal production in 1951 was only 3 million tons less than production for the entire United States in 1890.

The growth of this Commonwealth into the greatest industrial state in the nation has been due to the huge resources of easily accessible coal found by the early set-

tlers. It was the development of these deposits that provided the United States with a new source of fuel energy. This energy, when used in the form of hard coke made possible the growth of our nation's steel plants in the vicinity of Pittsburgh. Consequently, for two generations or longer, it was Pennsylvania industry that provided the steel for the nation's railroads, the supports for its bridges, and the frames for its skyscrapers. For nearly a century, the Commonwealth was the chief power house of our nation and the chief source of its industrial blood and bone. Since the early 1920's, however, the relative importance of soft coal in the nation's economy has sharply declined, as has the relative position of Pennsylvania as a coal producer. As these two facts are of important consequence to the economy of our state, it is necessary that all of the knowledge available be brought to bear upon the study of changes that have occurred in this vital industry. Because of the far-reaching effect which any decline in Pennsylvania's bituminous coal production exerts upon other industries, it is important for us to develop a sound plan for our State's industrial and social adjustment to present day conditions.

In our present twilight zone between war and peace it is necessary that we maintain maximum coal mining capacity, for coal is strength. Without it there can be no heavy industry, nor any of the thousand and one derivative industries whose products make the American standard of living the highest in the world.

During the past decade, the soft coal production curve for the United States reveals a great increase in activity as compared with the doldrums of the 1930-1940 period. From 1940 to 1945 the armament effort carried the industry to the greatest heights it had ever known. For five years after the war the national output of coal remained at a relatively high level, though oil and natural gas assumed a larger and larger share of the national market. This resulted in their providing the nation, at the close of the decade, with more of its fuel energy than did coal.

United States Bituminous Coal Production (Millions of net tons)

1910-1914	.....	average	435
1915-1919	.....	"	509
1920-1924	.....	"	491
1925-1929	.....	"	529
1930-1934	.....	"	371
1935-1939	.....	"	400
1940-1944	.....	"	554
1945-1949	.....	"	556

Of more importance to our Commonwealth is the fact that the percentage of the National production contributed by Pennsylvania has steadily declined.

From 1890 to 1915, Pennsylvania produced approximately 38% of United States coal. From 1915 to the present year, Pennsylvania's share of the National output had dropped to approximately 20%.

Why has our State's percentage of the employment and output in the soft coal industry declined?

In broad outline, this has been due to two factors:

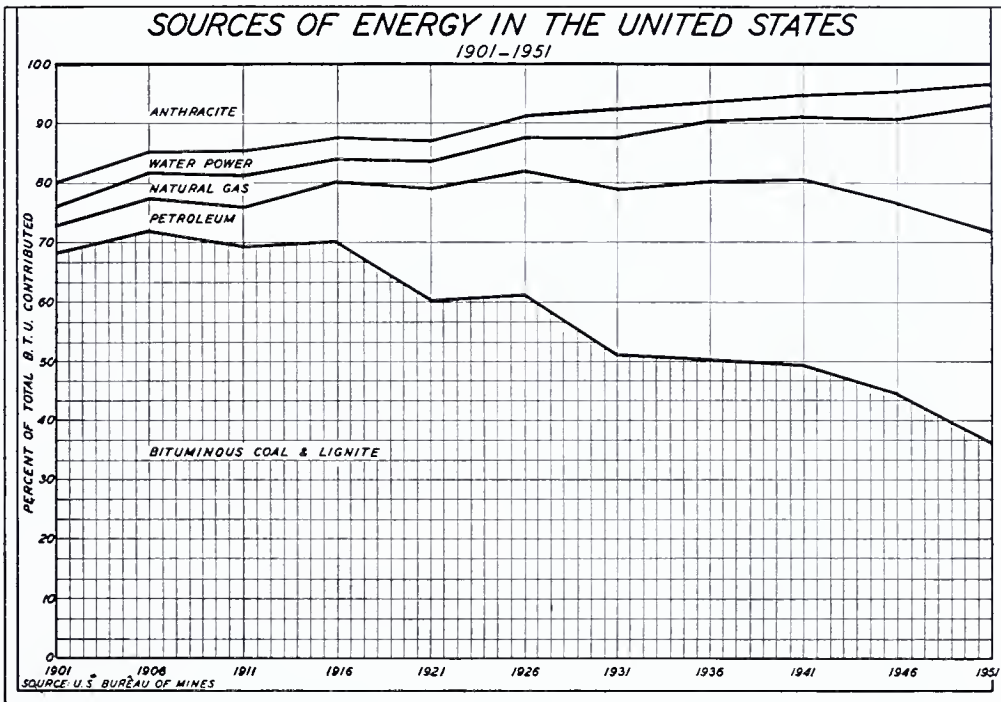
1. The high cost of labor and the inability of many small operators to mechanize sufficiently to offset this cost. (26.3% of Pennsylvania's production comes from mines with an output of less than 100,000 tons a year. In West Virginia, our State's chief rival, only 14% of production comes from mines that small. Approximately one-seventh of Pennsylvania's production comes from mines with an output of less than 50,000 tons a year, while only one-fourteenth of West Virginia's output comes from such smaller mines.)

2. The lower cost of production in other competitive coal fields due to geologic and other factors, including the necessity for miners to travel and for equipment to haul longer distances to the coal face from the mine mouth, a natural consequence of the greater age of Pennsylvania's workings. Despite such advantages in cost enjoyed by the newer fields, it can properly be claimed that Pennsylvania's location, close to the principal industrial centers of the East, provides a natural basis for competition which would enable our State's producers to meet the prices of

other fields if transportation costs, in all cases, were based fairly on the length of the haul between the mines and the consumer.

Unfortunately for Pennsylvania's position in the soft coal trade, this competitive advantage of location, offsetting the lower cost of production in younger fields, has not been allowed to operate in a way that maintains free competition. The freight rate structure evolved long ago to stimulate production in the South so nearly equalizes the cost of shipments to some of the principal markets, irrespective of length of haul, that Pennsylvania's producers no longer enjoy an equal chance to compete.

On the following pages will be found the factual basis for the above statements, a summary of the past record of bituminous coal as an energy source, and recommendations for the improvement of our State's position in the industry.



COMPETITIVE FACTORS

THE above figure shows quite clearly the effect of competition on the coal industry. It will be noted that coal's proportion of the energy consumption of the United States since 1906 has steadily declined although the nation's demand on its energy resources has so greatly increased that the total coal production between 1940 and 1950 was greater than at any time in our nation's industrial history. This decline in coal's relative contribution to the energy output of our country occurred despite the heavy demand for electrical energy and for metallurgical coke during the period of the Second World War and during our present accelerated defense effort.

Coal's competitive situation may be better understood by a comparison of the 14% of total BTU Equivalent contributed by petroleum and natural gas in 1914 with the 54% claimed as their share in 1950.

The use of natural gas is growing faster than that of any other American fuel. Over a 20-year period, 1930 to 1950, it has approximately doubled its contribution to the energy consumption of the nation. Of the other fuels,

petroleum has increased 40%, while bituminous coal has declined 30%, and anthracite has dropped 60%.

Comparative Fuel Prices—1952—Phila. Industrial, Commercial and Domestic Uses

<i>Fuel</i>	<i>BTU</i>	<i>Price</i>	<i>\$ Per Therm¹</i>
Gasoline	21,400/lb.	\$ 0.24/gal.	.192
#2 Fuel Oil	18,600/lb.	13.00/100 gal.	.087
Pa. Bit. (L.V. Run of Mine)	15,480/lb.	13.50/ton	.044
Pa. Bit. (H.V. Stoker Pea)	14,000/lb.	11.75/ton	.042
Anthracite (Pea)	14,400/lb.	18.95/ton	.066

Source: Computed from Petroleum Facts & Figures 1950—API, Anthracite Institute Bulletin.

¹ Therm equals 100,000 BTU.

The competitive effect of natural gas may best be gauged by a look at consumption figures for 1938 and 1948. At a fuel equivalent of 24,800 cubic feet of gas per ton of coal, it will be noted that equivalent consumption has increased from 48,156,000 tons to 140,298,000.

Natural Gas Consumption, 1938 and 1948 (Millions of Cubic Feet)

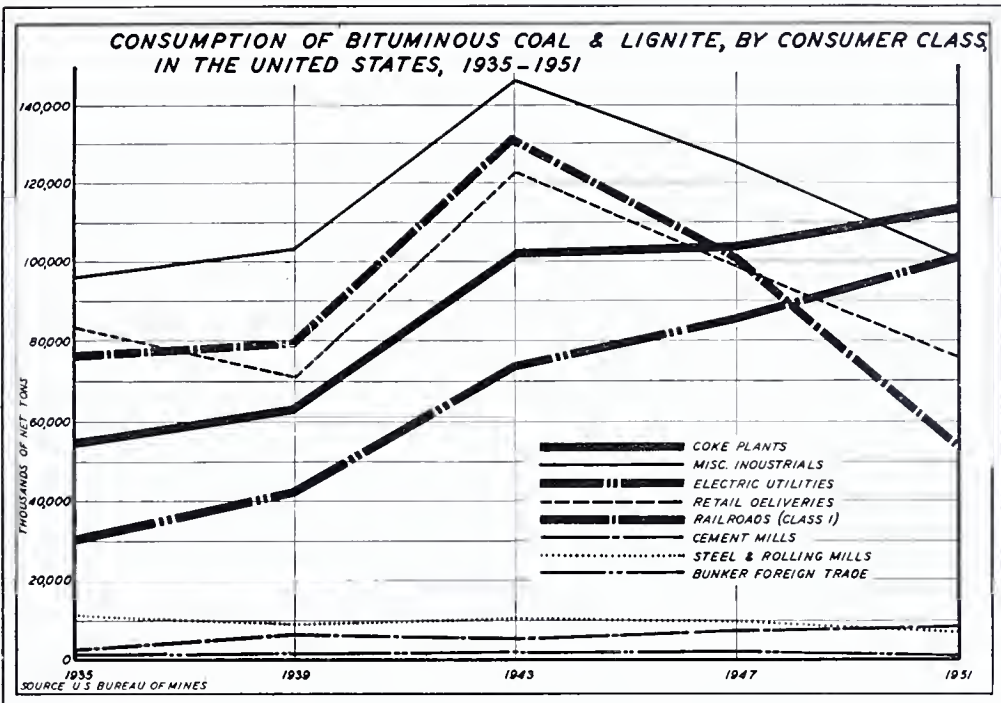
	<i>1938</i>	<i>1948</i>	<i>% Increase</i>
Domestic	362,000	896,348	148
Commercial	114,000	323,054	183
Portland Cement	37,336	72,139	92
Electric Utilities	170,688	478,097	180
Other Industrials*	510,261	1,709,979	235
Total	1,194,285	3,479,617	191

Source: Minerals Year Book, 1940 and 1950.

* Not including consumption at oil wells and for carbon black.

This phenomenal growth is due to greater ease of handling, and the convenience of combustion without an ash residue, as well as to the lower cost of automatic gas-burning equipment for domestic heating, as compared to equivalent coal-burning devices.

It is not strictly correct to say that natural gas consumption is competitive only to coal, for all energy resources are in fact competitive to one another; it is however true



Electric utilities and by-product coke plants are now the leading coal consumers.

that coal could supply, and has in the past supplied all of the types of energy needs enumerated above.

Although natural gas is the fastest growing fuel on the market today, petroleum is still coal's major competitor. A look at the table below will show that oil consumption is also growing at a substantial rate. The increased use of petroleum and natural gas for domestic heating has diminished in the main, the use of anthracite rather than that of bituminous coal. However, the increased use of oil-burning furnaces in industrial operations, and in the heating of commercial buildings and apartment houses (influenced to an important extent by the smoke control law) has caused a serious loss of business to the soft coal operators. In addition, the vastly increased consumption of diesel oil and gasoline in the past 10 years has cut quite deeply into the railroad market for bituminous coal.

United States Sale of Fuel Oils,
By Uses, 1939-1949 (Thousand gallons)

	1939	1949	% Increase
Vessels (Including Tankers) . .	79,254	102,483	29
Gas and Electric Power Plants	32,039	92,642	189
Smelters, Mines, Manufact. . . .	67,043	149,057	122
Heating Oils	136,232	250,801	84
Railroads	63,235	102,071	61

Source: Petroleum Facts & Figures.

The trend to dieselization is so pronounced that only 13 steam locomotives were ordered in 1949, as compared to 1,785 diesel units. (All 13 steam locomotives were ordered by one company.) It must be pointed out that some diesel locomotives contain more than one unit. The differential is, however, still substantial.

Locomotives in Use at End of Year—
United States Class I Steam Railroads

	1940	1949
Steam (Coal)	33,703	23,433
Steam (Oil)	6,338	5,531
Electric	858	817
Diesel Electric (Units)	797	10,888

Source: Petroleum Facts and Figures.

In 1934 the railroads consumed 21% of the total coal production of the United States. By 1951 this had dropped to 10%. The loss in the railroad market may be better understood when one realizes that the latest model steam locomotive achieves an efficiency of 8% as compared to 25% for the modern diesel. Most steam locomotives are even less efficient since 72% of the locomotives in the service of our Class I railroads are over 25 years old. The average efficiency of these older engines hovers about 3%. Therefore, despite the fact that coal purchased by the railroads costs about 22¢ per million B.T.U. as compared to 76¢ per million B.T.U. for diesel oil, the Class I railroads of the nation paid \$0.31 per 1,000 gross ton-miles for coal in 1951 and only \$0.16 for diesel oil.¹

¹ Based on statement M-230, Interstate Commerce Commission.

Date of Construction of Steam Locomotives (As of December 31, 1951)

	<i>Number of Locomotives</i>
Before January 1, 1915	6,893
Between January 1, 1915 & December 31, 1919	4,102
" " 1, 1920 " " 31, 1924	4,704
" " 1, 1925 " " 31, 1929	2,860
" " 1, 1930 " " 31, 1934	800
" " 1, 1935 " " 31, 1939	650
" " 1, 1940 " " 31, 1944	1,297
" " 1, 1945 " " 31, 1949	411
Year 1950	12
Year 1951	18

Source: American Association of Railroads.

In an attempt to combat the trend to dieselization a new coal-burning gas turbine engine is in the process of development under the direction of Bituminous Coal Research, Incorporated. This locomotive operates on pulverized coal. The fuel is burned by blowing it through a nozzle into the combustion chamber, the hot gases produced are used to operate a turbine, and the power is then used to drive generators. These, in turn, supply electricity for traction motors. The result of treating the coal like a fluid is to produce an engine with an 18-22% efficiency, depending on the load. Although this is less than diesel efficiency, oil, as we have noted, is more expensive than coal. It is estimated that at a 4,000 horsepower load the coal-burning gas turbine will require \$11.20 worth of coal per hour, while a two-unit diesel will burn \$22.75 worth of oil.¹ This locomotive is, however, at present only in the experimental stage.

In addition, several railroads are attempting to develop a steam turbine electric drive locomotive. Coal would be burned under a water tube boiler to produce steam which would be fed into a turbine to produce power for electric generation.

In addition to its losses in the railroad market the coal industry has also seen a decrease in the domestic, industrial, and bunker demands.

¹ Locomotive Development Committee, Bituminous Coal Research.

Retail deliveries, chiefly for space heating and miscellaneous industrial uses have declined in importance. In 1934 these two categories accounted for 51.2% of all coal consumed. Today they account for 40.7%. Although the amount of coal used to bunker American registry vessels has actually shown an increase, *total* bunker fuel consumption declined from 1,318,000 tons in 1939 to 781,000 tons in 1949, a decrease of 41%.

The competitive position of bituminous coal in the fuel market has, also of recent years, been seriously affected by imports of residual fuel oil from refineries in the Dutch West Indies and Venezuela. These imports are largely received on the East coast at such ports as Boston, New York, Newark, Perth Amboy, Philadelphia, Chester, Paulsboro and Baltimore, in the natural marketing area of Pennsylvania's central bituminous coal district. The total of residual oil imported in 1952 was approximately the equivalent in heating units of 30 million tons of bituminous coal.

The two bright spots in the coal picture are the electric utilities and the coke plants. Over a 17-year period the electric power plants have increased their coal consumption 243%. This tremendous increase from 29,707,000 tons in 1934 to 101,898,000 in 1951 has been accomplished despite a 21% decline in the amount of coal required per Kilowatt hour because of increased efficiency of generating equipment. The development of coal-burning generating equipment utilizing the smaller sizes of coal has so decreased operating costs as almost to price oil or gas out of this market. This factor coupled with the increased demand for electric power has resulted in a tremendous commercial market for coal. The success of coal as a power producer for electric utilities is best illustrated by the recent purchase of 28 million tons on contracts ranging from ten months to ten years by the TVA. This means that by 1956 TVA will be burning 13 million tons a year, and will be producing 50% of its power from coal. Its present ratio is 86% hydroelectric and 14% coal.

Pounds of Coal Consumed per Kilowatt Hour in Solid Fuel Generating Plants

1919	1924	1929	1934	1939	1944	1949	1950	1951
3.20	2.20	1.66	1.45	1.38	1.29	1.24	1.19	1.14

Source: Bituminous Coal and Lignite in 1951—U. S. Bureau of Mines.

Hydroelectric power is not a serious competitive factor in the national picture inasmuch as its contribution to the total BTU equivalent contributed by fuels and water has only shown an increase from 3.2% to 4.4% in 51 years. The failure of water power to dominate the market despite its apparently low cost is due to the inaccessibility of many power sites, the high cost of transmission over long distances, and the high capital costs of constructing dams and hydroelectric stations.

Consumption of coal by coke plants has increased 122% in 17 years. Beehive coke production included in the above figure, has been greatly stimulated by the demands of the Second World War and the present emergency because of the need for every ton of coke that can possibly be produced. This has, however, resulted in the annual loss of the byproducts from 10,000,000 tons of coal.

The byproduct ovens are the largest producers of coke due to the fact that one ton of coking coal is capable of producing 1,450 pounds of coke, and in addition, 27 pounds of ammonium sulphate for the manufacture of fertilizers, explosives, and chemicals, 12 gallons of tar for the production of drugs, aniline dyes, pitch, flavoring extracts, and perfume as well as 11,500 cubic feet of gas for heating and lighting. The profit engendered in such an operation has made it desirable to locate byproduct coke plants close to steel mills and to cities which can make use of the coke oven gas for domestic or commercial heating. Beehive ovens which have no byproducts for sale are located close to the mine to eliminate unnecessary haulage.

Despite the high efficiency now attained in the use of coke for pig iron production, increased war and postwar

demand for iron has resulted in serious depletion of our reserves of coking coals. In order to combat this trend the higher grade coals are being blended with lower grades. It is believed that this will save 4 to 5% of the better kinds of coking coal every year. Increasing economies in the use of fuels are steps in the direction of progress, and are necessary for the conservation of state and national resources. The coal industry has in the past appeared rather to gain than to lose through each improvement in the economical use of its product. Such economies seem eventually to lead to increasing demand because of the improved competitive position that results.

Pounds of Coke per Ton of Pig Iron

1913	2,173	1947	1,900
1918	2,121	1948	1,908
1937	1,807	1949	1,870

Source: Bituminous Coal and Lignite 1951—USBM.

Conservation of coal would seem to provide a clue to a proper answer to the inroads made on the coal industry by competitive fuels. To find more efficient ways to burn and use bituminous coal might enlarge the market for it in fields other than power generation and coke production.

Until recent years the coal industry has not often considered its domain to extend much beyond the mining of the fuel. Consequently, it has always been essentially a bulk-handling industry, with little thought for research which might subsequently expand the use of its product. It was not until 1933 that a cooperative program of research was introduced into the industry with the establishment of Bituminous Coal Research, Incorporated.

The success of petroleum is the result of a difference in philosophy. The oil industry was built on research. Once Edwin Drake had shown how to take crude petroleum out of the ground it was necessary to find a use for the vast quantities of it which could be produced. As a result this industry, even in the earliest years, spent many millions of dollars to develop new products and to devise new methods of production, until today crude petroleum is the basis of vast, complex, and highly profitable industries.

MINING TRENDS AND PROBLEMS

Operating Cost Factors

DESPITE the seriousness of the competitive situation described above, the coal industry's major problem lies in its inability to make money even when the demand for its product is record breaking. In 1947 when the pent up desire for civilian goods boosted coal production to a high of 631,000,000 tons the industry as a whole was unable to earn as much as other mining industries.

Data on Profits and Operations as a Percentage of Sales of Mining Industries—1947

	<i>Operating Profit¹</i>	<i>Net Profit after Income Taxes</i>	<i>Maintenance and Repairs</i>	<i>Depreciation, Depletion, Amortization</i>
<i>Bituminous Coal . . .</i>	11.2%	7.9%	7.3%	3.1%
<i>Crude Petroleum & Natural Gas</i>	31.5	27.9	3.4	25.4
<i>Gold and Silver Ore</i>	40.0	26.4	5.5	4.4
<i>Iron Ore</i>	24.2	10.8	..	20.9
<i>Nonferrous Metals Ore (No Gold or Silver)</i>	20.4	14.9	7.2	4.6
<i>Sulphur</i>	43.4	32.7	3.8	6.5
<i>Miscellaneous Extractive</i>	22.4	14.5	8.4	5.5
<i>All Mining</i>	18.9	14.6	6.1	8.9

¹Net sales after deduction of all operating expenses, including taxes other than income.

Source. Survey of Listed Corp., 1946-47, Part VII, Securities Exchange Com.

The Table above is offered only for comparative purposes and does not necessarily represent conditions as of 1953. It covers only companies listed with the Security Exchange Commission which are among the largest and most efficient producers in the industry. In addition to this fact, it must be recalled that the year 1947 was a peak year for bituminous coal production.

An analysis of the sales, general, administrative, depletion and amortization factors involved in the production of coal would seem to indicate that these expenses are no higher than those of other mining industries. Maintenance and repair expenditures are higher, but this is due to the corrosive nature of the water in coal mines as well as to the abrasive quality of the material produced. It should be noticed that maintenance and repair for the non-ferrous mining industry which includes such metals as copper, zinc and lead is also high due to a like situation. From this it would seem that the failure of the industry to earn a fair operating profit is due in large part to the cost of labor and the inability of the mine owners to assist that labor with modern machinery to an extent adequate to assure a satisfactory return on their operations.

The rate of pay of the bituminous miner is among the highest for workers in any major industry. The average weekly earnings of the soft coal miner, in 1951, was \$77.86 for an average of 35.2 hours as compared to \$64.88 for 40.7 hours for workers in all manufacturing industries. Workers in the crude petroleum industry earned \$79.67 per week. However, they worked an additional 5.7 hours to earn this \$1.81 more than the bituminous coal miner. Considering the danger and discomfort of the work, the miner is most certainly entitled to a good wage. Further, most miners, due to conditions at the mine mouths, live at a considerable distance from their work.

Rates of Pay for Various Classifications of Labor—September 29, 1952

	<i>Hourly Rate</i>	<i>Day Rate</i>
Motormen, Rock Driller, Rubber-tired Shuttle		
Car Operator	2.31	18.44
Drivers, Brakemen, Spraggers, Trackmen, Timbermen, etc.	2.28	18.25
Pumpers, Trackmen, Helpers, Wiremen Helpers, Timbermen Helpers	2.25	17.96
Loading Machine Operators	2.59	20.68
Loading Machine Operators Helpers	2.43	19.40
Cutting and Shearing Machine Operators and Helpers	2.59	20.68
Drillers and Shooters	2.43	19.46

Source: Joint Report of the International Officers—1952—United Mine Workers.

For most localities in the United States the relatively high day rate shown above does not represent an increased labor cost per ton of coal, but rather a moderate decline in such cost as a result of improved methods of extraction. On the other hand, the high percentage which labor cost bears is a disadvantage when coal must be sold in competition with oil or natural gas. For a number of years this disadvantage was emphasized for Pennsylvania by the differential in Union wages as opposed to non-Union wages.

The non-union fields were predominantly located in the south while the union fields were in the north. The National Labor Relations Board in 1938 reported that against a standard wage of \$7.50 in the union field the non-union fields were paying approximately \$5.00. This resulted in a cost differential of more than 50 cents a ton between non-union and union coal. As a result the southern operators were able to move into many of the markets formerly claimed by Pennsylvania producers. Unionization, and consequent equalization of wages, eventually came to virtually all coal mines in the East. This, however, came at a time when Pennsylvania, for various geologic and other reasons, was no longer a low cost producer. Consequently the State's operators have been unable to recover the markets lost during the period of wage discrimination.

Comparative Labor Costs by States—1950-1951

<i>State</i>	<i>Tons per Man per Day</i>		<i>Labor Cost per Ton</i>	
	<i>1950</i>	<i>1951</i>	<i>1950</i>	<i>1951</i>
Kentucky	6.39	6.82	\$2.48	\$2.32
Ohio	10.21	10.35	1.55	1.53
Pennsylvania	5.95	6.01	2.66	2.64
West Virginia	6.41	6.66	2.47	2.38

Source: Computed from Bituminous Coal and Lignite in 1951, Market Report No. 2102, U. S. Bureau of Mines and Wage Data from the United Mine Workers.

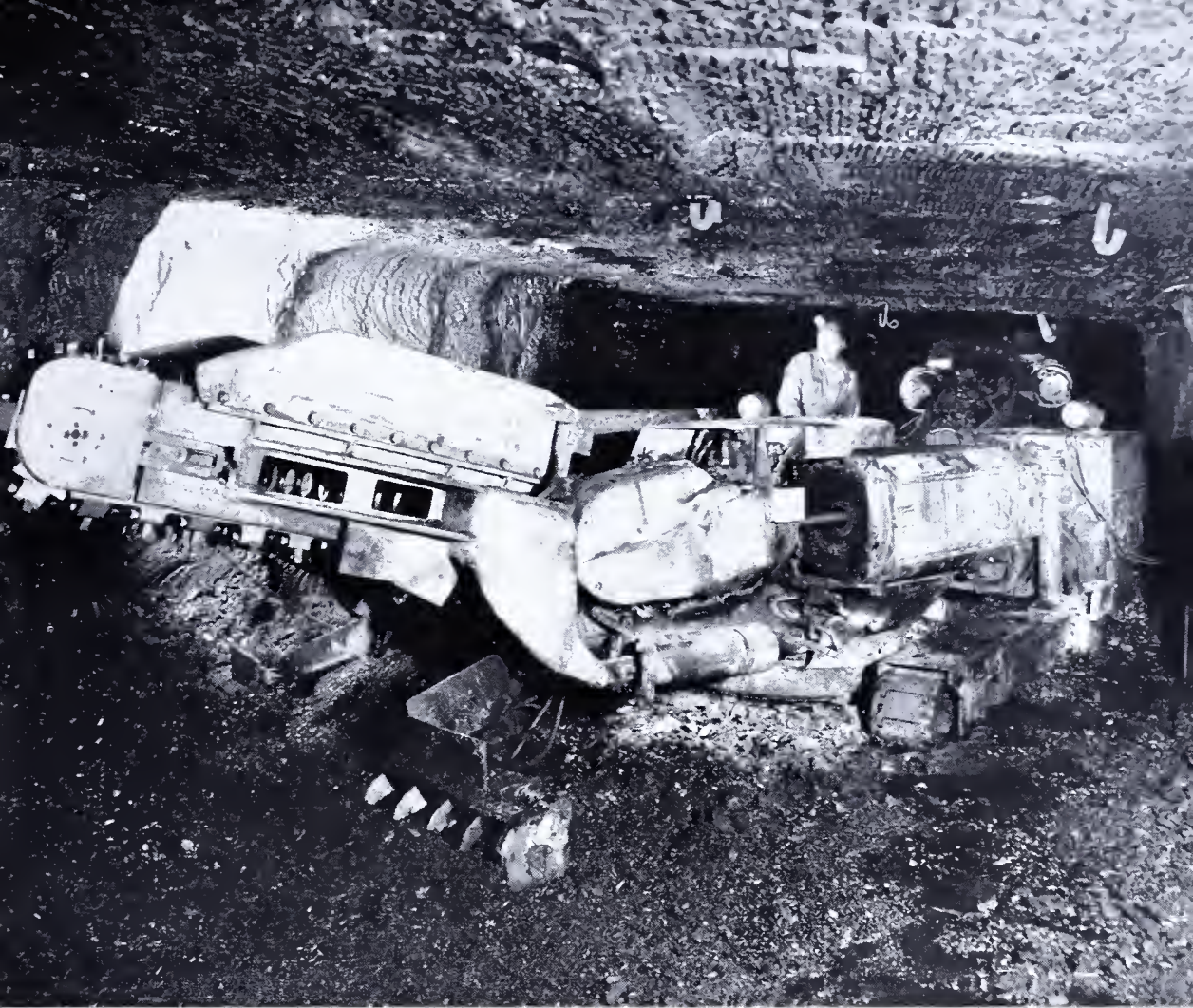
A solution of the problem of production costs in the bituminous coal industry is not made easier by seasonal and cyclical changes in demand and by other periods dur-

ing which production is at low ebb while maintenance and financial costs continue without compensating income.

An industry whose product is frequently in active competition with other energy sources is peculiarly sensitive to conditions, however arising, which permit rival fuels to invade its market. Long term considerations indicate that whatever will assist in maintaining coal's competitive position will also have a powerful influence in stabilizing employment and improving the economic position of the producing counties.

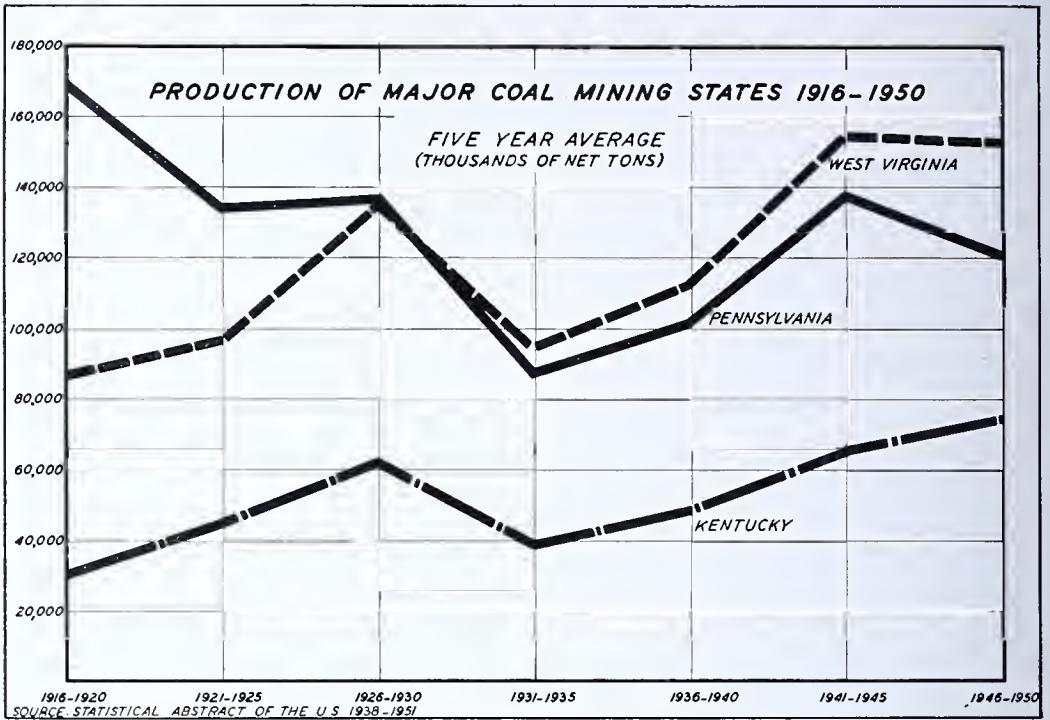
The answer to the high costs facing the bituminous coal industry would seem to lie in the direction of mechanization, for it has been found that as the mechanization of a mine increases the output per man day likewise increases. However, the benefits resulting from a decrease in labor costs are partially offset by heavier investment and the greater financial risk involved.

It is hoped that eventually the tons per man day can be increased to such an extent that the effect of the high wages necessarily paid to labor will be offset. That this point can be eventually reached would seem to be indicated by the fact that it was not so very long ago that travelers in Europe described the workings of coal in the mines of England by saying, "in the process of hewing the coal from its bed the hewer first digs as far as he can to the bottom of the strata then he nooks or corners off the part measured out and afterward the great coals come away by a wedge or mallet." From these early beginnings we have developed an industry which today does utilize tremendous quantities of machinery. This industry pushed by the inevitable rise of labor costs to the point where profit was being eaten up has continued its forward progress until today it is on the threshold of a revolution, as momentous in its meaning to the mining of coal as the industrial revolution was to the world as a whole. This may well change the entire form and system of mining. The trend toward mechanization has already produced self-propelled machines to perform each individual operation, from timbering to loading. It was only a step further to the development of a machine capable of both mining and loading the coal.



A Continuous Miner cuts coal from the face and loads it into mine cars.

In 1949 the Sunny Hill Coal Company and the Joy Manufacturing Company each announced the completion of a continuous miner. These machines can best be described as giant moles. They move under their own power, ripping the coal from the face and loading it onto the mine transportation system, all in one operation. The Continuous Miners are capable of producing 500 to 1000 tons per shift. The actual production rate will, however, vary with the coal seam and with the ability of the transportation system to haul the coal away. The introduction of these two machines has stimulated other manufacturers. By the end of 1950 there were three types in use, as well as two in model form and two others designed and ready for construction. Although the mechanical miner brings with it problems of transportation, ventilation, dust con-



For twenty years West Virginia has led Pennsylvania in its output of bituminous coal.

trol, and labor rates, it also provides cheaper coal. Operating data show a cost reduction of from 25 cents to \$1.00 per ton over costs of more conventional mining systems.¹ The efficiency of this machine is best evidenced by the fact that 170 of them were in actual use by the end of 1951.

In order further to reduce the cost of a ton of coal, a new substitute for timbering the mine roof has been developed. Where it is possible to use this system, known as roof bolting, expanding-end bolts are driven through the roof of the mine. This results in the consolidation of several strata into one, thus making the roof stronger and better able to bear the load of the overburden without its being supported by timbers. The elimination of timbers provides more working room.

Despite the various advances made in the mining of coal, Pennsylvania has been hard put to keep up with its

¹ J. V. Beal, Coal Mining Faces a Transformation, Mining Engineering, Feb., 1949, p. 34.



A track-mounted cutting machine in a mechanized Pennsylvania bituminous mine.

competition. A comparison of production figures shows that Pennsylvania has slipped in its proportion of the national production while the other major producers have improved. Of the three largest coal producing states in the nation Pennsylvania is the only one that has failed to soar to new production heights as compared to 1930. Pennsylvania's production has shown a downward trend since 1918, while West Virginia and Kentucky have shown rising trends. This is not to be wondered at, since the Commonwealth is the oldest coal producer in the United States. In the process of providing 30% of the total output of U. S. bituminous coal to date we have removed through production and mining losses close to 20% of our original reserves, much of it our highest quality

coals. This state originally ranked in eighth place in point of total coal reserves. As of 1950 we had dropped to 11th place.

The long continued operation of a mining industry in a limited location usually leads to problems of increasing cost of extraction and to the eventual depletion of the more readily available sources of coal or ore. This has proved true with the iron deposits in the great Mesabi field and is no less true as to the coal deposits of Pennsylvania, the first to be developed, and for many years the chief source of mineral fuel in our nation.

Reserves (USBM)—Major States (Thousands of Tons)

<i>State</i>	<i>Original Reserves</i>	<i>Produced or Lost¹ in Mining 1/1/50</i>	<i>Remaining Reserves 1/1/50</i>	<i>Recoverable Reserves (50% Recov.) 1/1/50</i>
Illinois	171,905,000	6,263,994	165,641,006	82,820,503
Kentucky	123,327,000	3,903,606	119,423,394	59,711,697
Ohio	86,497,000	3,388,518	83,108,482	41,554,241
Pennsylvania	75,093,459	14,731,582	60,361,877	30,180,939
West Virginia	116,618,447	9,958,770	106,659,677	53,329,838

¹ Produced or lost calculated by doubling Bituminous Production from earliest date to 1950. Anthracite Reserves subtracted from original Bureau of Mines estimate for all Pennsylvania coal.

Source: Min. Market Report 2102—USBM, 1951.

The data quoted in the above table reveal the fact that, of the principal coal-producing areas, Pennsylvania has contributed more to the national fuel supply than any other state. These statistics do not, however, tell the whole story. With the depletion of Pennsylvania's thicker and more accessible coal deposits, thinner and thinner seams have necessarily been mined. This mining of thinner seams has been carried out primarily by small producers. Under modern marketing conditions where coal produced by hand is being sold in competition with coal cut and loaded at high speed by elaborate and expensive machines, the operators of small mines are often unable to afford the type of machinery necessary to bring their costs in line with those of larger competitors in our own and other states. In many cases it would actually be un-

economic to install costly machines for their limited production as the following table shows:

Cost of Machines—1952 (Average Prices)¹

Rubber Tired Universal Coal Cutter	\$38,000
Loading Machines	18,240
Continuous Miners	67,000
Shuttle Cars	17,275

¹ Computed from information supplied by the following companies: The Jeffrey Company, Lee-Norse Company, Myers-Whaley Company, Goodman Manufacturing Company and The Joy Manufacturing Company.

The seriousness of this handicap is best illustrated by the fact that only 7% of West Virginia's production comes from mines producing less than 50,000 tons per year, while 15.6% of our coal is mined by these small producers. Conversely, only 60% of our production is from mines with an annual production exceeding 200,000 tons, while West Virginia produces 75.1% from such mines.

Classification of Mines by Size—1951

State	500,000 tons and over			200,000 tons to 500,000			100,000 to 200,000		
	No. of Mines	% of No.	% of Prod.	No. of Mines	% of No.	% of Prod.	No. of Mines	% of No.	% of Prod.
Pennsylvania	48	2.7	42.6	64	3.6	17.4	105	5.9	13.7
West Virginia	77	6.0	39.7	182	14.1	35.4	122	9.5	10.9
	50,000 to 100,000			10,000 to 50,000			Less than 10,000		
	No. of Mines	% of No.	% of Prod.	No. of Mines	% of No.	% of Prod.	No. of Mines	% of No.	% of Prod.
Pennsylvania	165	9.3	10.7	580	32.8	12.3	810	45.7	3.3
West Virginia	161	12.5	7.0	427	33.1	6.0	320	24.8	1.0

Source: Report 2102—U. S. Bureau of Mines—1951.

In addition to the fact that many of our mines are small and cannot possibly afford to install full mechanization because of the scale of their operation, is the fact that on the average the remaining seams of coal in Pennsylvania are somewhat thinner than those of competing states.

We are mining on an average, seams 4% thinner than those of West Virginia, and in general thinner than the seams of the other major producers. This Commonwealth is the only producer deriving an annual production exceeding 800,000 tons from seams less than two feet thick.

Thickness of Seams Mined Percent of Product—1945

	<i>Less 2</i>	<i>2-3</i>	<i>3-4</i>	<i>4-5</i>	<i>5-6</i>	<i>6-7</i>	<i>7-8</i>	<i>8-</i>
Pennsylvania . . .	1.1	5.5	28.9	16.6	15.7	19.8	6.4	6.0
West Virginia . .	x	5.0	26.8	21.2	12.6	17.0	11.5	5.9
Kentucky	.2	4.7	37.0	36.8	10.6	8.0	x	x
Ohio	x	7.1	18.6	59.3	13.6	1.3	x	x
Illinois	.2	.8	6.1	13.5	12.0	21.9	25.4	20.1

Source: Thickness of Coal Seams—U. S. Bureau of Mines—1945.

These geological conditions in Pennsylvania have resulted in an average output per cutting machine that is lower than the production of West Virginia and Kentucky. Thick seams allow a miner to move about more easily and to operate loading equipment and hauling systems more efficiently.

Cutting Machines—1951

<i>Number</i>	<i>Average Output per Machine Tons</i>	<i>Machine Production Tons</i>	<i>Percent of Total Output Underground Mines</i>
Pennsylvania 3,172	25,190	80,078,170	94.4
West Virginia 4,382	33,239	145,655,111	96.9
Kentucky . . . 2,129	26,638	56,711,857	89.7
Ohio 655	24,850	16,277,026	99.6

Source: Report 2102—U. S. Bureau of Mines—1951.

Further insight into the problem may be gained by comparison of Pennsylvania's 4.1% of underground production cut by hand compared to 0.5% and 0.9% for Kentucky and West Virginia respectively. In addition to this comparatively high percentage of hand cutting Pennsylvania has been hand loading 31% of its underground production as compared to 23% for West Virginia.

Because of local conditions, some Pennsylvania mines still haul coal by ropes or by mule cars. In 1951 our mines were using 1,736 animals for haulage compared to West Virginia's 1,252 and we were utilizing 3,293 rope haulage units as compared to 488 in West Virginia. Between 1947 and 1951, however, animal haulage decreased by 25%.



A train of loaded coal cars passes a train of empties on this Pennsylvania underground railway.

Without the eventual mechanization of most of our mines it is doubtful if we would be able to continue to compete in the coal markets of the nation. However, the growth of mine mechanization has, in its turn, created many problems in coal preparation since automatic loaders gather up dirt and rock from the floor beneath the coalbeds. This tends to increase the amount of refuse which must be discarded in the cleaning process.

The growth of mechanical methods of mining has thus compelled a parallel growth in the various methods for cleaning coal since increased efficiency in coal-burning devices has led to a greatly intensified consumer demand for cleaner and cleaner coal. Price is not the only considera-

tion in moving coal to markets. Other qualities, such as freedom from refuse, high caloric value and a low ash content are equally important to large consumers. In 1951, 42.8 percent of Pennsylvania's coal was mechanically cleaned. The cleaning plants rejected refuse to the total of 10,377,000 tons in obtaining 40,153,000 tons of clean coal. The ratio of refuse to raw coal prepared in our State's cleaning plants was 20.5 percent as compared to 16.1 percent in West Virginia and 15 percent in Kentucky. Since it is as costly to mine a ton of refuse as a ton of coal, the higher percentage of refuse which must be discarded in the State's cleaning plants is reflected in a lower productivity of merchantable coal per man day of labor and in a higher consequent production cost, as is shown in the following table:

Underground Bituminous Coal Mined in 1951

	<i>Tons per man day</i>	<i>Value per ton at mine</i>
Illinois	9.01	\$4.15
Indiana	8.23	4.19
Ohio	6.81	4.33
West Virginia	6.35	5.33
Kentucky	6.05	5.08
Virginia	5.55	5.47
Pennsylvania	5.24	5.64
Alabama	4.60	6.18

This higher cost, a complex of many factors most of which are the inevitable consequence of the age of our State's coal mines, is the essence of Pennsylvania's competitive problem which would be very difficult of solution if surface mining had not provided a low-cost method of extraction and if the State had not always possessed the one important advantage in the location of its coal deposits which are closest to the great industries of the north-eastern part of the United States.

Strip Mining

The high cost of extracting a ton of coal underground has resulted in an expansion of strip mining. This method of production has increased its annual contribution in this state from less than 1% of the total in 1935 to 22% in 1951.



Trucks being loaded in this Pennsylvania strip pit will dump their coal directly into railroad cars.

Today Pennsylvania is the largest producer of strip mined coal in the United States.

Stripping is not a new system of mining, but rather an old one. The earliest mines in this country were begun by ripping the soil from the outcrops of the coal bed. However, these mines were unable to compete with the then more efficient underground mines, and stripping disappeared. It was not until 1940 and the second World War that open pit coal mining really hit its stride. At that time the introduction of large shovels and dump trucks able to haul 3 to 10 tons at a time, combined to make this method far cheaper than underground mining.¹

¹ M. N. Shaffner, Bituminous Coal Strip Mining in Penna. Bulletin of Pa. Dept. Internal Affairs, January, 1947.

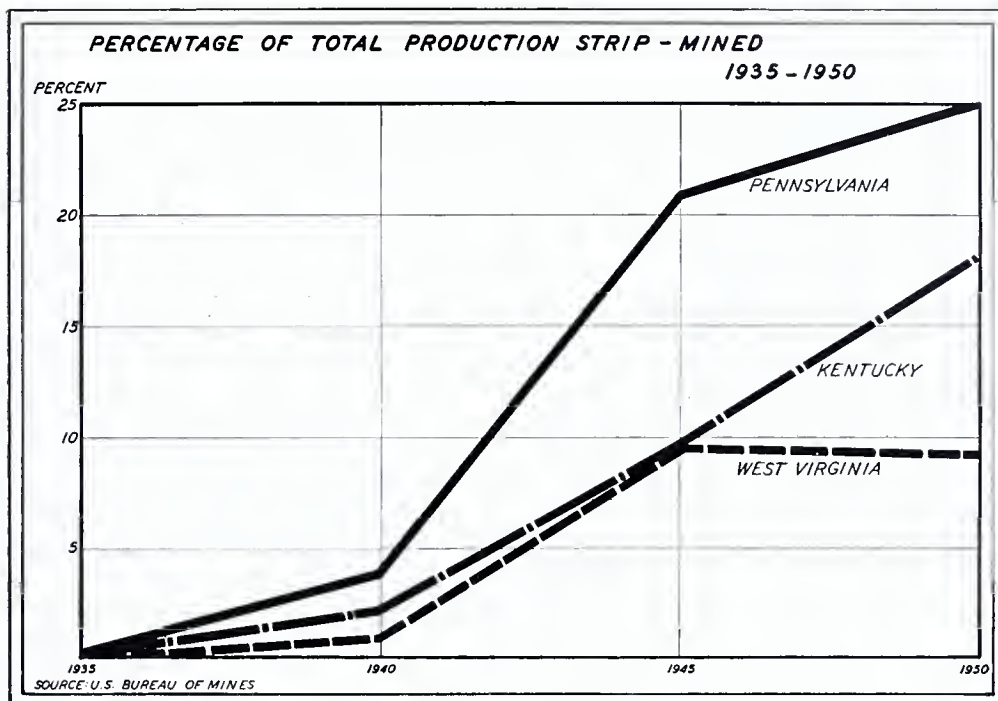
This form of mechanization results in tremendous economy in the use of labor. In 1952 a total of 8,149 men produced 23,356,343 tons in the strip pits, as compared to 63,173 men for 84,807,500 tons underground. On the average, each underground miner produces 5.24 tons per day, while each stripper turns out 12.82 tons per day. This greater efficiency results in much lower costs. Assuming that the unweighted average daily earnings in the strip pits is \$18.45, and in the underground mines \$18.93¹, we find that it would cost \$3.73 per underground ton, and \$1.48 per surface ton, for labor. The average value was \$5.64 and \$4.02 respectively, thus making the labor cost as a percent of value 66.1% underground, and 36.8% above ground.

In addition to this striking saving, recovery above ground is close to 100%, while recovery by mining underground is approximately 80%. Further, stripping has a negligible water problem, requires no timbering or ventilation work, and the operator pays a 50% lower insurance premium. As if these advantages were not sufficient, the preparatory development of a deep mine is a long and expensive proposition. Production from a surface mine usually begins 1 to 3 weeks after the equipment has been moved to the location.

Despite the advantages which have led to the growth of this type of mining, there are certain physical limitations to the further expansion of this method. Under present systems a ratio of 8 feet of overburden (surface covering) to 1 foot of coal can be removed at a profit, but this ratio represents the approximate limit beyond which stripping is not justified by the present market price of bituminous coal. This limitation is further narrowed by the scarcity of suitable quality coal close to the surface.

Because of the high percentage of Pennsylvania's coal produced in the strip pits, the average value per ton for the State's entire production, though higher than that in Kentucky or West Virginia, presents a more favorable picture than would be possible if our proportion of deep-

¹ Computed from data supplied by United Mine Workers of America.

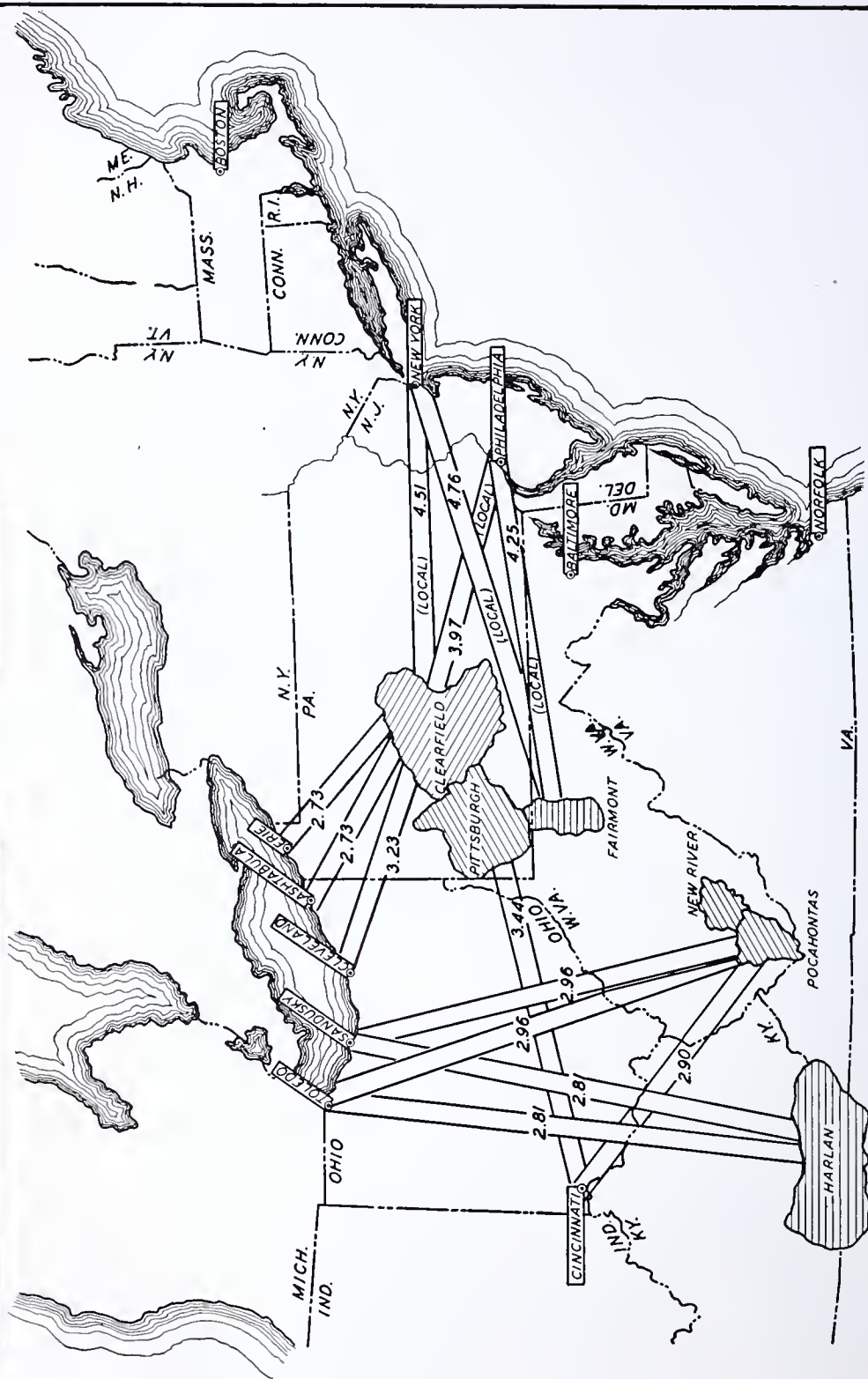


Nearly one-fourth of all Pennsylvania bituminous coal is produced from open pit mines.

mined coal was as great as that for either of our principal competitors. This dependence on the strip pits is, however, a source of future danger since the supply of desirable coal close to the surface is, as noted above, far more limited than that available at greater depths.

It must also be realized that some of the same handicaps of an older and well-worked coal field are also evident in surface mining. Tons per man day in Pennsylvania's strip pits, although notably higher than in its underground mines, are, nevertheless, lower than in the surface mines of either Kentucky or West Virginia.

Despite the fact that the State produces a considerable tonnage of premium coal, Pennsylvania is left with only one important advantage to enable it to maintain employment for the 80,000 workers in its bituminous mines. This advantage is that of location, an advantage toward which the State's vast production of both hard and soft coal greatly contributed, by stimulating industrial development, in the northeastern part of the United States.



The rail rates shown on this map practically eliminate the locational advantage of Pennsylvania's bituminous coal fields in shipments to important markets.

TRANSPORTATION COSTS

IN ADDITION to the many other problems facing the coal industry rail freight rates are of prime concern. These have, for many years, been a major item of cost in the sale of coal. Over the years the cost of transporting a ton of coal from mine to market has, in most cases, exceeded the value of that coal at the mine. In the table below the average figures given show quite clearly that as late as 1940 this condition prevailed. Today the average percentage of freight cost to cost at mines has declined. There are, however, many instances in which the transport of coal still costs more than the coal itself.

Mine Realization and Freight Costs U. S. Average

<i>Year</i>	<i>Mine Realization</i>	<i>Railroad Freight Cost</i>	<i>Total</i>	<i>Freight % of Total</i>
1935	\$1.77	\$2.24	\$4.01	56%
1940	1.91	2.22	4.13	54%
1945	3.06	2.20	5.26	42%
1950	4.84	3.09	7.93	39%
1951	4.87	3.11	7.98	39%

Source: Bituminous Coal Annual—1952—(Adapted from ICC & Bureau of Mines data) Bituminous Coal Institute.

In an attempt to circumvent these high rates a large coal producing company installed, in 1951, a three mile experimental pipe line system. Fine-sized coal is mixed with water, and the flow is pumped through a 12" pipe line. At the destination the coal is dried and prepared for sale. Company officials believe that they will be able to launch a commercial pipe line within 5 or 6 years. However, a lack of demand for fine-sized coal must be overcome before it will be practicable to utilize this method of transportation.

This is not the first attempt to reduce transport costs. In the early days of the motor truck it was believed that

this new fangled contraption was the answer. However, because of the great weight and bulk of coal it has not been feasible to ship it long distances over our highways. Consequently, the railroads are still the principal carriers of bituminous coal. There has been little change in the percentage of coal which they have hauled during the past fifteen years.

Percent Carried by Transport Means United States

<i>Year</i>		<i>Railroad</i>	<i>Water</i>	<i>Truck</i>	<i>Other</i>
1935-1939	Average	84.7	5.3	6.8	3.2
1940-1944	"	83.5	5.6	7.4	3.5
1945-1949	"	83.6	4.7	8.8	2.9

Source: Bituminous Coal Annual—1952—Bituminous Coal Institute.

Thus, pending the development of a more revolutionary method of transport, the coal industry must learn to live with the railroads. In order better to understand the reasons for the high rates and seeming inequities it would be well to discuss the principles upon which rail rates are based.

The railroads have a larger fixed cost than ordinary business. Estimates place this fixed cost at $\frac{2}{3}$ of total railway expenditures, the other $\frac{1}{3}$ being dependent upon traffic volume. Consequently, they must operate at full capacity to make a profit. To maintain top volume a railroad will charge that rate for each item which will make the largest total contribution to fixed overhead expenses. In short, commodities capable of being transported by some other means will be granted rates to meet competition while freight unable to move any other way will pay higher rates in order to ensure overall operative profits.

The high fixed costs result in the transport distance being far from the only determining factor in arriving at freight rates. However, in order to simplify the tariff system most rates are based on distance to this extent: the rate increases with distance, though the rate per mile decreases with the length of the haul. Thus we find that

the ton-mile rate for a 200-mile haul will generally be greater than the ton-mile cost of a 400-mile haul, since the rail rate must cover terminal costs which are independent of distance.

The distance rate is further modified because, as stated above, each railroad is required by economic factors to develop as much traffic for its line as possible. Therefore, rates to a common market from various sources of supply are adjusted so that the more distant producers can compete with the more favorably located mines or factories.¹

It is this characteristic of freight rate structure that has, in certain cases, severely hampered the sale of Pennsylvania coal. In fact, in some instances the rates seem in need of complete revision, since they are based upon an earlier supremacy of the Pennsylvania mines which no longer exists.

Since labor rates are now generally uniform between the northern and the southern coal fields the two important factors determining the competitive position of bituminous coal produced in Pennsylvania as compared with West Virginia and Kentucky, are cost of extraction, which has already been considered, and distance from markets.

It is quite apparent from an examination of the prevailing and the historic rate structure on soft coal that the Interstate Commerce Commission has quite properly attempted over the years to encourage the movement of coal from more distant sources to the principal markets by a low ton-mile rate. Over the course of these same years, however, as we have shown, Pennsylvania's advantages as the primary coal producer of the United States have slowly declined due to the exhaustion of its most available sources of easily-mined coal, and also due to the fact that for many years production costs in the southern mines have been generally lower than in the Keystone State.

It is obvious from figures already presented showing the decline in the relative importance of Pennsylvania's

¹ D. P. Locklin, *Economics of Transportation*, 1938.

bituminous coal production, and particularly its shipments to eastern markets, that the adverse factors in its competitive position have been permitted to dominate its favorable factors, which are today largely confined to the proximity of its mines to the principal markets in the industrial east and on the Great Lakes.

The Lake ports are among the most lucrative markets for coal. Pennsylvania's proximity to this area would, under normal conditions, make it the natural supplier. This, however, has not been permitted to happen. The rail rates for local shipments to Sandusky and Toledo are so arranged that the Clearfield field pays the *same* rate (\$3.75) for a haul that is 29 to 106 miles *shorter* than that from the West Virginia fields. The Pocahontas and New River producers, with a haul averaging 132 miles more than the Pittsburgh mines to Sandusky and Toledo are only paying \$0.25 more.

Lake Cargo Coal Rates (Net Tons) Transshipment

<i>From</i>	<i>To</i>	<i>Rate</i>	<i>Short Line Miles</i>	<i>¢/- Ton-Mile</i>
Clearfield	Erie	\$2.73	176	1.6
"	Ashtabula	2.73	179	1.5
"	Cleveland	3.23	228	1.4
Pittsburgh	Erie	2.46	145	1.7
"	Ashtabula	2.46	120	2.1
"	Cleveland	2.46	131	1.9
Hocking	Toledo	2.43	184	1.3
Pocahontas	Sandusky	2.96	394	0.8
"	Toledo	2.96	407	0.7
New River	Sandusky	2.96	350	0.8
"	Toledo	2.96	363	0.8
Harlan	Sandusky	2.81	461	0.6
"	Toledo	2.81	453	0.6

Source: Interstate Commerce Commission.

It is obvious that the West Virginia, and particularly the Kentucky producers, have been granted an exceedingly low ton-mile rate for the distances involved.

Of more importance than the local rates are those for trans-shipment to western areas or Canada over the Great Lakes. In the case of Clearfield to Cleveland the Pennsylvania field is being charged \$0.27 to \$0.42 *more* to

send coal an average of 170 miles *less* than the southern fields pay to Sandusky and Toledo. An extreme case of this advantage enjoyed by southern producers is found in the Harlan to Sandusky haul. Here the southern producers are permitted to haul coal 233 miles *more* than the Clearfield-Cleveland haul for \$0.42 *less*.

Local Rates—Lake Port Coal (Net Tons)

<i>From</i>	<i>To</i>	<i>Rate</i>	<i>Short Line Miles</i>	<i>¢ per Ton-Mile</i>
Clearfield	Sandusky	\$3.75	288	1.30
Pittsburgh	"	3.50	191	1.83
Pocahontas	"	3.75	394	0.95
New River	"	3.75	350	1.07
Clearfield	Toledo	3.75	334	1.12
Pittsburgh	"	3.50	235	1.49
Pocahontas	"	3.75	407	0.92
New River	"	3.75	363	1.03

Source: Interstate Commerce Commission.

It would seem that the Lake-port rates are in need of revision, for they have caused extreme damage to the Pennsylvania producers. Shipments to the Lake ports from this Commonwealth have shown a 34% decrease over the past 43 years while the other fields have shown phenomenal increases.

Lake Cargo Shipments (Thousands Net Tons)

	<i>Pennsylvania</i>	<i>West Virginia</i>	<i>Kentucky</i>	<i>Ohio</i>
1909	8,055	4,329	8	2,918
1919	7,080	7,387	1,425	5,840
1929	7,774	19,561	6,814	3,209
1939	9,259	21,245	7,998	2,356
1950	6,200	27,300	10,076	5,106
1951	5,352	22,854	7,991	4,852

Source: Seward's Annual 1952.

To the industrial east coast where consumption of soft coal for electrical generation might provide an important market, Clearfield, more than 100 miles closer to New York and 98 miles closer to Philadelphia, is allowed only a margin of 25 to 28 cents over Fairmount, West Virginia, as shown by the following Table supplied by the Interstate Commerce Commission, as of December

1, 1952. These rates are subject to Ex Parte 175 increases which have now been granted and still further decrease the percentage this margin bears to the total delivered cost of the coal.

(Rates in Cents per Gross Ton)
From Producing Districts

<i>To</i>	<i>Fairmount, W. Va.</i>			<i>Clearfield, Pa.</i>	
	<i>Local Rate</i>	<i>Trans-shipment Rate</i>	<i>SL Mileage</i>	<i>Local Rate</i>	<i>SL Mileage</i>
New York	476	(b) 361½	447.1	451	338.6
Philadelphia, Pa.	425	(d) 397	364.1	397	266.0
		(b) 321½			
Baltimore, Md.	425	(c) 397	278.1	397	242.0
		(b) 314½			

Explanation of Reference Marks:

SL—Short Line mileage.

(b) When placed in vessels destined to New England Ports and reshipped from latter ports to destinations in Conn., Maine, Mass., New Hampshire, Rhode Island, or Vermont.

(c) When delivered to vessel destined inside Chesapeake Capes.

(d) When delivered to vessels destined inside Delaware Capes.

Shippers in the Clearfield district contend that this differential now bears so low a percentage to the total cost of coal production that it does not allow them to compete in the important eastern markets. Certainly, in view of the very favorable ton-mile rate accorded southern shippers to the Lake ports, as compared to shipments from Pennsylvania, this differential of 25 to 28 cents for a haul which in shipments to New York is 108 miles shorter from the Pennsylvania mines, and in shipments to Philadelphia 98 miles shorter, provides little or no advantage to compensate for the higher cost of production.

In the interest of the nation as a whole and the full utilization of its resources of fuel energy, the development of the southern coal fields through favorable rail rates was undoubtedly a foresighted policy, and it can not be denied that this policy has met with great success since the output of the West Virginia fields has for a number of years exceeded that of Pennsylvania. The time has obviously arrived, however, for a re-examination of the

rail rate structure, both to the Great Lakes and to the Atlantic seaboard from that same consideration of long-term public policy.

Huge resources of bituminous coal are still available in Pennsylvania despite the overwhelming contribution the mineral industries of our State have made to the national wealth. The disadvantages which the southern fields first encountered in their development were disadvantages of distance from Canada and from the Atlantic coast and New England markets. Compensation for those disadvantages through favorable rail rates has permitted the southern fields with their newer mines and, at one time, lower wage rates, to dominate many of Pennsylvania's most important markets. It is not in the national interest, however, that these advantages be pushed too far. The fuel resources of Pennsylvania's mines should not be forced out of a competitive position by a rail rate structure which, under present day conditions, gives the southern fields too heavy an advantage. Pennsylvania's resources of mineral fuel and the advantageous location of those resources in the industrial east are important national assets which should not be wasted.

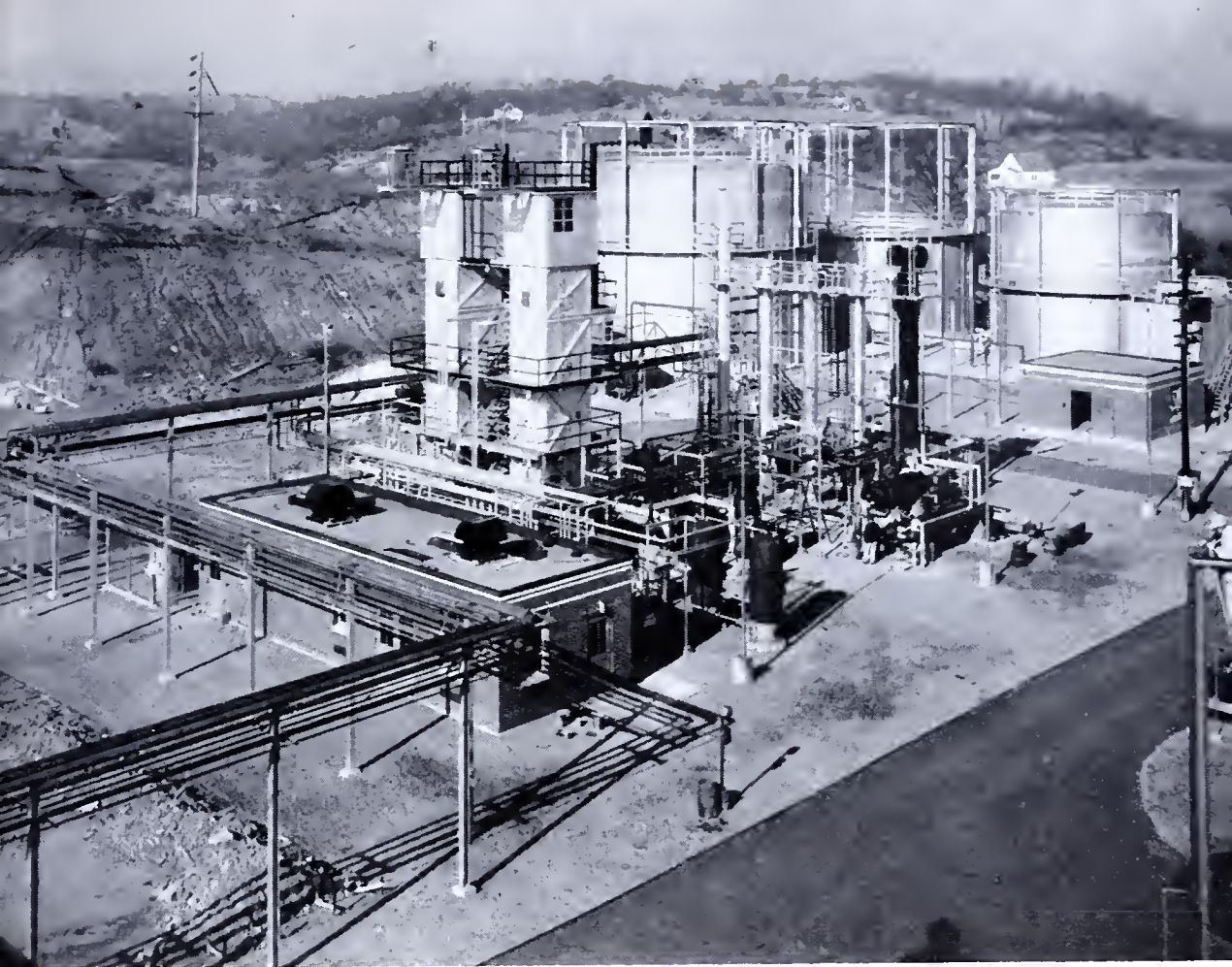
If the present competitive position of many of Pennsylvania's bituminous coal producers is not improved, a further decline in the State's position in the industry seems imminent. In the decade between 1941 and 1951, while the national production rose by 19½ million tons, Pennsylvania's output declined by 22 million tons. In the ten years from 1941 to 1951, employment in Pennsylvania's bituminous coal mines showed a decline of 39,179 workers, a loss of 31.7 percent. During the same period there was also a decline in employment of 18.4 percent in the bituminous coal mines of the United States, but it is obvious that the losses in Pennsylvania, nearly half of the national total, were far heavier than for the industry as a whole. This disproportionate loss of employment in Pennsylvania presents clear evidence that despite its vast reserves of desirable coal and the shorter haul from its fields to the Great Lakes, the eastern seaboard and the largest concentration of population in the nation, Penn-

sylvania's producers are operating under a serious handicap and in many markets are unable to compete with rival fields on even terms.

If coal mines are closed by inability of the producers to operate in competition with more favored coal fields, miners will drift away or adopt other callings, and their services will be no longer available if the nation's need for solid fuel should suddenly rise in an emergency, as it did rise during the Second World War. At such a time the strategic location of Pennsylvania's presently recoverable reserves, totaling between 30 and 40 billion tons, might well prove vital to the national safety, but closed mines can rarely be re-opened for satisfactory operation. Flooded coal measures often represent an energy resource which may never again be tapped. The same philosophy which encouraged the development of the resources of the southern fields should, in all justice, be now applied to retaining as an effective part of the nation's economy, the treasures of power remaining under Pennsylvania's hills.

In confirming certain of the rates quoted above, Mr. J. Hayden Alldredge, Chairman of the Interstate Commerce Commission, wrote as follows:

"I might explain that the rates on coal are not as a rule based on the distance from each mine or shipping point, but are generally made on a group or district basis. The rates from the various groups or districts are often related, that is, the rate from one group may be made a differential over or under the rate from the base group. It is, therefore, not unusual to find substantial differences in the rates from mines in the various groups for the same length of haul. Moreover, the rate from one coal district may be relatively higher than the rate from some other district to a common destination, due to the fact that shippers in the higher rated district do not market in that particular destination area and the rates therefore have not been adjusted in relation to those from other districts."



Experimental gas synthesis plant of U. S. Bureau of Mines at Bruceton, Pennsylvania, produces chemicals and liquid fuels from bituminous coal.

THE FUTURE OF BITUMINOUS COAL

THE LONG-TERM future of the coal industry presents a much brighter picture than its near-term prospects. Before the industry stretches a period of transition which involves a gradual adjustment to the use of coal as the principal base from which will be derived chemicals, gaseous fuels, and liquid fuels, in addition to its presently unassailable position as the chief fuel source for the production of electric energy. However, let us now consider the various possibilities in detail.

Chemicals from Coal

The coal chemical industry already has been firmly established by the by-product coke oven. Gases driven off in the coking process are used to produce a tremendous number of products which, in their turn, provide a basis for the manufacture of plastics, sulphur drugs, weed killers, insecticides, fertilizers, moth balls and a multitude of chemicals. These uses can be greatly expanded.

With this end in view, coal industry research is being built primarily around the production of a solid fuel that can be sold, with chemicals and synthetic liquid fuels as by-products in proportions that can be regulated according to market demand. Consequently, the industry is developing an extension of the coking process known as low-temperature carbonization. This is nothing more than a means of roasting bituminous coal in the absence of air. This process yields a number of hydrocarbon liquids and gases and a burnable solid coke or residual char composed of finely divided material suitable for power station fuel. It would be sold at the equivalent coal B.T.U. price, and consequently at a loss. The volatile elements, however, contain a variety of ingredients which can supply premium products such as the phenols, creosols, selected xylenols, a cresylic acid fraction, electrode carbon, and high-boiling tar acids. Most of the chemicals so produced would be suitable for plasticizers and polymers for the plastic industry. This 30 to 40 gallons of material per ton must bear the operating costs and yield the capital return.

The Pittsburgh Consolidation Coal Company believes that low temperature carbonization has an advantage over other processes in that it requires less capital, and provides a gradual approach to adapting coal conversion to changing economic conditions. Pittsburgh Consolidation Coal¹ estimates that coal hydrogenation requires approximately 10 times the investment per daily ton required for carbonization. Therefore, to balance the difference in capital cost the hydrogenation liquid product must be worth a

¹ Communication from H. Turner, Director of Research, Pittsburgh Consolidation Coal Company.

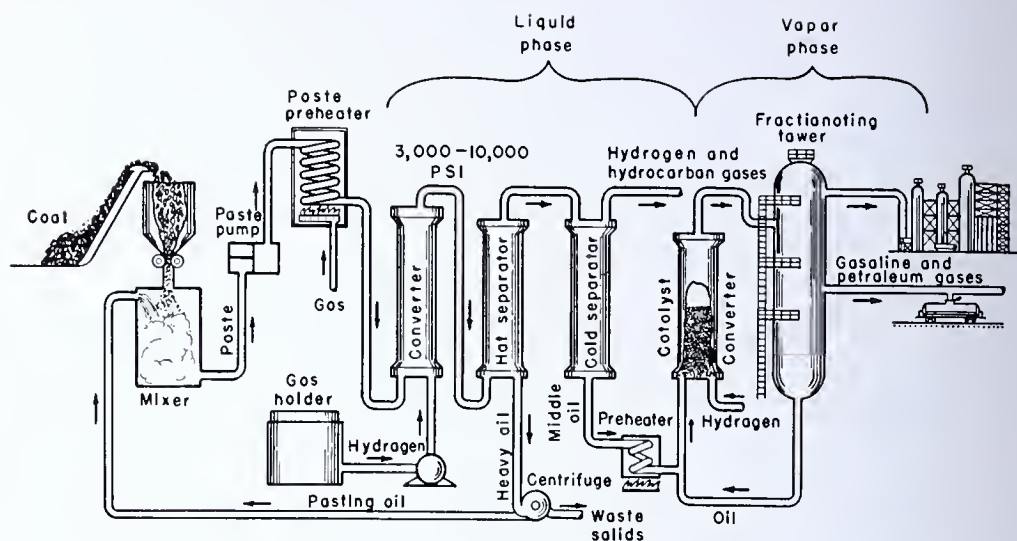
good deal more than the carbonization liquid product per gallon. Further, hydrogenation requires hydrogen in large quantities. This gas is expensive to produce from its present major sources—natural gas or through the gasification of coal. The foregoing is the position taken by a major company which is, after all, primarily interested in the production of a fuel.

Another approach to the problem is that of the Koppers Company and the Union Carbide and Carbon Corporation. These are primarily interested in the production of chemicals. In an article which appeared in the April, 1952 issue of *Mining Engineering Magazine*, Mr. E. E. Donath of the Koppers Company stated that the oils produced by the hydrogenation process are the raw materials for the preparation of aromatic chemicals, tar acids, and tar bases. The products would consist of 6.1% by weight of tar acid, 50.8% aromatics, 16.6% liquified propane gas and 26.7% gasoline. The actual chemicals produced are dependent upon the type of catalyst used, and the temperature and pressure under which the oils are treated. Mr. Donath believes, however, that with the proper treatment, the development of a comprehensive flow sheet, and the addition of certain equipment all of the following products could be obtained on the basis of 30,000 barrels per day.

<i>Product</i>	<i>Yield</i>	<i>Product</i>	<i>Yield</i>
Phenol	2%	Mixed Aromatics	7%
m-p-Cresol	2.5%	Ethylbenzine	3%
Xylenols	1.6%	Napthaline	4%
Benzine	8.2%	Motor Gasoline	16%
Toluene	14%	Aviation Gasoline	11%
Xylenes	15%	Ammonium Sulphate ..	450 Tons
		Sulphuric Acid	89 Tons

These could be used in the production of dyes, fertilizers, cortisone, cleaning fluids, plastics and a thousand other items.

One of the major difficulties in the production of chemicals by hydrogenation is the high initial cost. It is be-



A flow chart of the hydrogenation process.

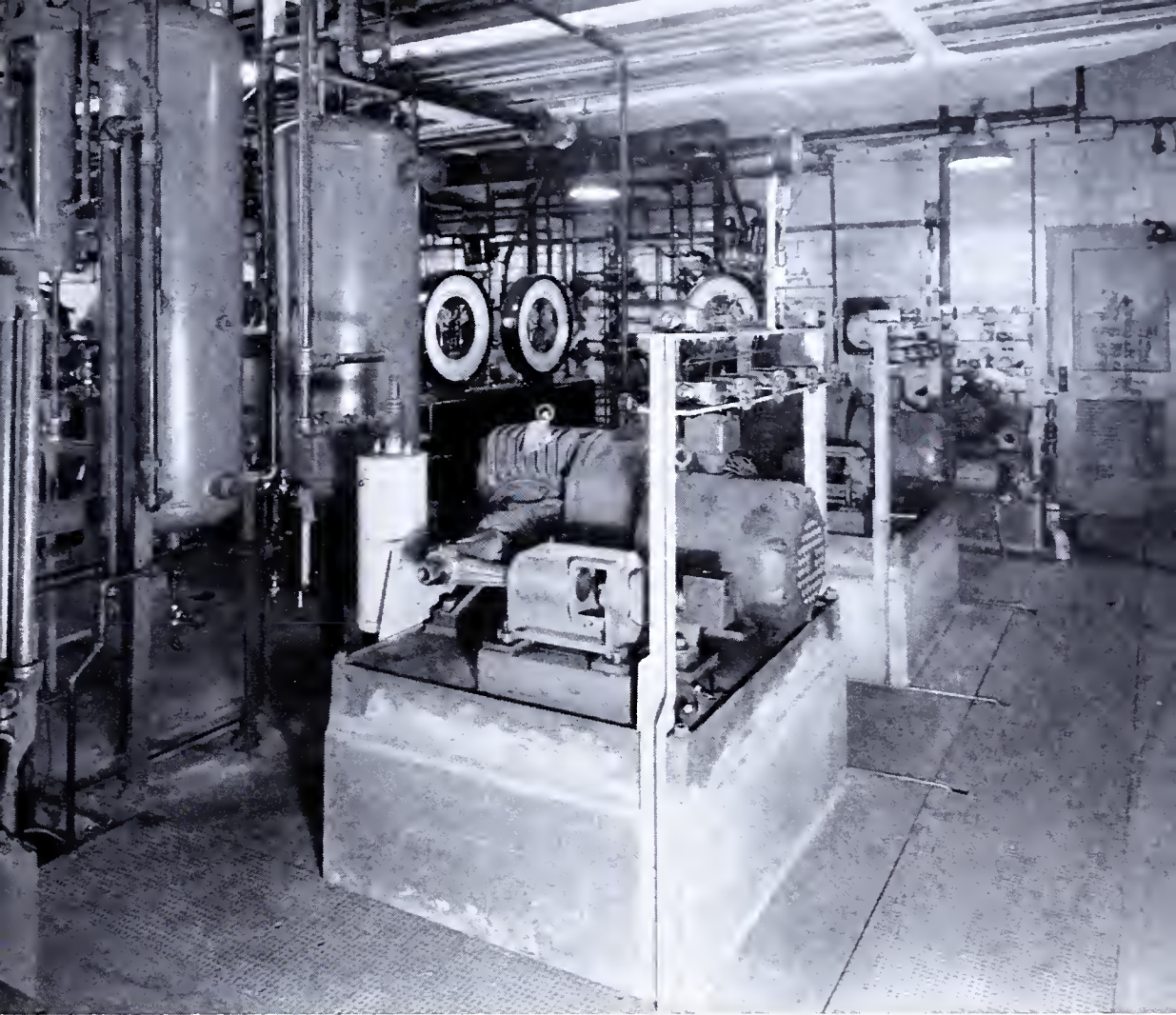
lieved that the construction of a 30,000 barrel per day plant would cost in the neighborhood of \$326,000,000.

The hydrogenation process is, however, believed by Union Carbide to hold so much promise for the future that they have constructed an \$11,000,000 pilot plant at Institute, West Virginia, for the primary production of chemicals directly from coal. This plant is the result of 17 years of research by this company.

Each of the above methods has its place in the scheme of things, depending upon the end product desired. Hydrogenation results in the complete destruction of the coal with the exception of ash and other mineral residuals. Low temperature carbonization results in the partial destruction of coal.

Synthetic Liquid Fuels

It should be noted that gasoline was also produced directly by the hydrogenation method mentioned above. This process, known as the Bergius-I. G. Farben Hydrogenation Process, was developed in Germany 20 years ago. It was operated commercially in that country both before and during World War II. Recently the United States

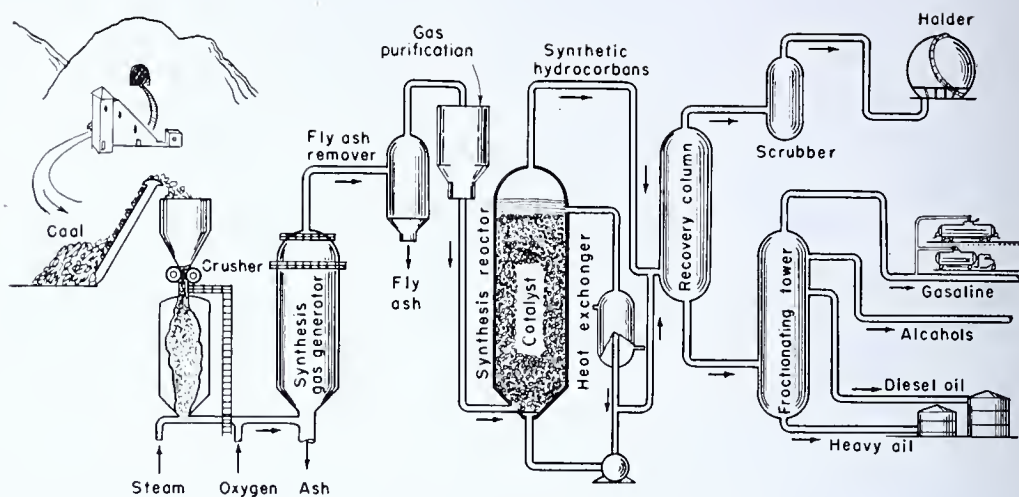


This pilot hydrogenation plant at Bruceton, Pennsylvania, produces oils, alcohols and gasoline from bituminous coal.

Bureau of Mines has operated a 200 barrel a day plant at Louisiana, Missouri, in an attempt to adapt this method to United States coal. The Bureau is now operating a 50 barrel a day plant for the production of liquid fuels by the Fisher-Tropsch gas synthesis method.

Under the Synthetic Liquid Fuels Act of 1944 experiments on these two processes have been further expanded by the construction of the Synthetic Fuels Laboratory at Bruceton, Pennsylvania. This laboratory is attempting to develop new and better processes for the production of chemicals and synthetic fuels.

The hydrogenation and Fisher-Tropsch methods produce different end products. In addition to its output of liquid fuels, the by-product chemicals in the hydro-



A flow chart of the gas synthesis process.

genation process are of the aromatic or naphthenic group, while those of Fisher-Tropsch are aliphatic alcohols and organic acids.

In hydrogenation the pulverized coal is mixed with an equal weight of heavy oil and a small percentage of catalyst. This paste is then pumped with hydrogen, through pre-heaters into a series of high-pressure vessels. By thus subjecting the coal to direct liquifaction under suitable conditions of temperature and pressure, we obtain a high octane gasoline suitable for aviation requirements. It should be noted that although 70% of Germany's total oil supply came from natural petroleum, they produced all of their wartime aviation gasoline by hydrogenation.

The Fisher-Tropsch method consists essentially of first gasifying the coal to produce a mixture of carbon monoxide and hydrogen. This is little more than the process used in every municipal gas works. After the hydrogen to carbon monoxide ratio has been adjusted, and the gas purified, it is passed over a catalyst, usually iron or cobalt. At this point it is subjected to a pressure of 350 pounds per square inch and raised to a temperature ranging from 400 to 590 degrees F. A mixture of gaseous, solid, and liquid hydro-carbons is formed which vary from paraffines to methanes. This process, as operated in Germany, yielded a

poor quality gasoline and a superior diesel fuel plus other by-products. Various American improvements have made it possible to use this method to turn out high grade motor fuel with a greater flexibility in the end products. The by-products include wax, small amounts of alcohol and hydro-carbon gases. Through cracking, the wax can be converted to fuel, or may be used directly in polishes, insulating materials, and chemicals. The alcohols are useful in chemical production. These alcohols, gallon for gallon, are worth more than gasoline on the present market.

At present, the pilot hydrogenation plant of the Bureau is able to produce a high percentage of aviation gasoline, or of diesel fuel, jet fuel or fuel oil as desired. It is also able to produce the many chemicals mentioned above.

These processes bring with them several problems. First, it is necessary to have available the proper type of coal for each method. The synthesis gas produced by the Fisher-Tropsch process must have as low a sulphur content as possible; therefore it may be necessary to use a low-sulphur coal to keep down the cost of de-sulphuring the produced gas. On the other hand, the Bureau of Mines believes that the high return possible from the sale of by-product sulphur will make the use of high sulphur coal feasible. Inasmuch as the gasification of coal may require rather high temperatures, it is necessary that a coal be used with a suitable ash fusion temperature to avoid the formation of clinkers.

The hydrogenation process requires, for maximum efficiency, a high volatile coal. The medium-low volatile coals are liquified to a lesser extent and consequently yield less oil per ton.

In addition to the volatile matter, the amount of mineral matter in the coal must also be considered. Should the fuel used have a high ash content, it would be necessary to remove this material before processing. Therefore, the cost of production would rise.

A further consideration in liquid fuel production is the huge quantities of water required. It is estimated that a

10,000 barrel plant would require a daily supply of 10,000,000 gallons of water providing that recirculation of the water was utilized, without recirculation 170,000,000 gallons would be required.

The United States Bureau of Mines estimates that a total investment of 8.7 billion dollars would be required to construct sufficient plant capacity to produce a daily output of 1,000,000 barrels of oil. It is believed that a 1,000,000 barrel per day production would enable us to produce 86,000 barrels of liquified propane and butane, 648,000 barrels of motor gasoline, and 266,000 barrels of diesel and furnace oil.

The cost per gallon of liquid fuels produced by these processes varies so considerably with the method employed and the range of products desired, that no estimate made at this time would be useful. So far as American experience is concerned, the operations have been conducted in pilot plants and for experimental purposes only. The range of estimates indicates that gasoline, diesel oil, and gases yielded by these several methods of liquid fuel synthesis, will not be prohibitively costly. They will not, however, be so cheap as to be commercially competitive at the present time with products from petroleum or natural gas. Moreover, enough is not yet known as to such costs on a commercial scale of production to indicate whether coal or the oil shales will be first drawn upon to produce the automotive fuels and sources of organic chemicals during the next phase of our industrial development.

Coal Gasification

Underground gasification of coal beds has also been experimented with. The Bureau of Mines, in cooperation with the Alabama Power Company, has set fire to various Southern workings. However, much of the gas produced in these experiments is burned before reaching the surface due to short circuiting of air after the burned cavity becomes enlarged. If this process is to become feasible this difficulty must be overcome.

It has been suggested that it might be possible to drill long, small-bore retorts with oil drilling equipment. These could then be fired, and the combustion kept going by a combination of air, oxygen, and steam. It is estimated this would provide a substantial savings since it costs \$3.00 to \$10.00 per foot to drive a man-size tunnel, whereas it only costs 60¢ per foot to drill 6 to 18 horizontal holes in coal.¹ However, no means of controlling the direction of the fire has been advanced. Coal mine fires once started are difficult to control even by the construction of concrete walls to limit the advance of the flame.

If these methods for underground gasification are eventually proved commercially practicable their application would drastically reduce mining costs, permit production from seams presently considered too thin, and reduce transportation costs by allowing the use of a pipe line. Gas thus produced could be fed into Fisher-Tropsch plants for conversion into liquid fuels and chemical by-products.

¹ Fortune magazine, March 1947.

CONCLUSIONS AND RECOMMENDATIONS

The most immediate problem of Pennsylvania's soft coal industry is to retain its relative position and employment and, if possible, to regain some of the lost markets for its products. Three courses of action seem obviously necessary if improvement is to be attained.

1. Some readjustment of the rail rate structure should be sought to restore the advantage of Pennsylvania's location in reference to the principal eastern markets and the Lake trade, and thus to permit a more equitable competition with the southern fields.

2. The industry should support and make available to its salesmen, courses of instruction in combustion engineering. Greater familiarity with the technical problems involved in the most efficient use of bituminous coal would greatly strengthen the position of that fuel in competitive markets by providing the coal salesmen, the men most important in establishing better relations between the consumers and the industry, with information necessary for attaining a more satisfactory and economical use of the industry's product. (Such a course has recently been instituted at The Pennsylvania State College with very encouraging results.)

3. Further research and the application of such research to problems of the production, preparation and utilization of bituminous coal are urgently needed. Research in this field can be of incalculable value to our nation and its industries and merits the support of Federal and State agencies, including our State-assisted institutions of learning, the bituminous coal producers and

organized labor. To meet the particular problems of Pennsylvania's soft coal industry, the following directions of inquiry and development seem most important:

The development of types of mechanical equipment specifically designed for operation in thin coal seams would prevent the permanent loss of valuable fuel supplies which cannot now be marketed because of cost of extraction.

Research on combustion methods should be intensified in order still further to increase the efficiency of coal-burning units on locomotives and in power generation. Emphasis on the technical problems and advantages of utilizing the various grades of Pennsylvania coal in a pulverized form seems particularly important.

Any substantial improvement in the operation of bituminous stokers for smaller industrial establishments might assist in the recovery of large losses suffered, particularly by the central Pennsylvania field, in supplying fuel for installations of a capacity between those designed for domestic heating and those adapted to public power generation.

Research should also be continued in regard to the possibility of utilizing larger admixtures of lower-grade coal in coke production.

In this connection, and to illustrate the possibility of economic advantage to the coal industry through technical research, attention is called to a recent publication of the U. S. Bureau of Mines, "Convertol Process of Coal-Slurry Treatment." The Convertol process, recently developed in western Germany, is a new method of cleaning and dewatering coal-washery slurries. It is a modified bulk-oil process, in which a very small quantity of heavy oil is dispersed over the surfaces of the coal particles, followed by a screen centrifuge operation in which the water and dirt (clay, shale, and pyrite particles) are thrown out through the screen perforations and the clean coal particles are retained on the screen and discharged as a dewatered, clean, coal product of 8 to 10 percent surface moisture.

It is reported, also, that the process oil, all of which is retained in the clean-coal product, adds to the coking power of the coal and facilitates the production of briquets, reducing the proportions of binding material required.

4. It is obvious that on a cost basis, at the present market price for petroleum and its products, the production of liquid fuels and organic chemicals from coal beyond what are already available from the by-product coke ovens, is still in the pilot stage so far as the United States is concerned. Bituminous coal is, however, the largest known natural resource on which we can rely with complete confidence to provide the fuel energy for the future needs of our nation. It also offers a practically inexhaustible source of the numerous hydrocarbons essential to our chemical industries. It is, therefore, obvious that the development of the most efficient processes for obtaining liquid fuels and organic chemicals from American coal is an important and urgent task for both government and industry.

SELECTED PUBLICATIONS OF THE PENNSYLVANIA STATE PLANNING BOARD

Publication
No.

- 1—Preliminary Report. 682 pages. 152 charts, December, 1934.
- *10—Drainage Basin Study. 3 vols., 611 pages, 1937.
- 17—Industrial Utility of Water in Pennsylvania. Chemical Character of Surface Water, 1944 to 1946. 1947.
- 18—The Pennsylvania Zoning Primer (Revised), 1948.
- 19—Local Powers for Community Development, 1948.
- 20—A Pennsylvania Recreation Manual, 1949.
- 21—Planning and Zoning Powers and Procedures in Pennsylvania, 1949. Vol. 1. (Townships of the Second Class, Counties, Regions.)
- 22—Planning and Zoning Powers and Procedures in Pennsylvania, 1949. Vol. 2. (Cities, Boroughs, First Class Townships.)
- 23—Industrial Utility of Water in Pennsylvania, 1946-1949. 1952. (A supplement to Pub. No. 17.)
- 24—Aerial Photographs as Tax Maps, 1952.
- 25—An Economic Background for Regional Planning in the Anthracite Area, 1952.

These publications may be seen in representative public libraries. A limited number of those listed are available for distribution until the present supply is exhausted. Those marked with an asterisk are now out of print but may be seen in representative public libraries.

The following issues of **Pennsylvania Planning** are still available.

- Population, October, 1942.
- Handicrafts in Post-War Planning, May, 1943.
- Plastics, July, 1943.
- Air Photographs, February, 1944.
- Light Metals and Stainless Steel, August, 1944.
- Topographic Mapping Needs, February, 1945. (For limited technical distribution.)
- Community Action for Local Self Development, July, 1945.
- Forest Resources, November, 1946.
- Soil Conservation, September, 1947.
- Minerals Conservation, December, 1948.
- Comparative County Data, August, 1950.
- Report and Program, January, 1951.
- Pennsylvania Anthracite, March, 1952.
- Know Your Pennsylvania, September, 1952.

